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VOL. CXXXVIII.—No. 3595] LONDON: FRIDAY EVENING, NOVEMBER 21, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

SALE BY TENDER.

Tenders are Invited for the PURCHASE, DISMANTLING, and REMOVAL of PLANT (Engines and Generators, Switchboard, and Air Compressor) from the Leeds Head Post Office.

Tenders will be received until 10 a.m. on Thursday, the 27th November, 1924.

Forms of Tender containing all particulars can be obtained on application to the Controller, Post Office Stores Department, Studd-street Depot, Islington, London, N. 1.

The Postmaster-General does not bind himself to accept the highest or any Tender.

By Order of the
POSTMASTER-GENERAL.

General Post Office,
November, 1924. 7546

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—

1. BODY IRONWORK and FITTINGS for RAILWAY CARRIAGES.
2. WHEELS and AXLES for RAILWAY WAGONS.
3. RAILWAY WAGONS.

Tenders due on the 12th December, 1924.
Tender forms obtainable from above. 7595

Executive Engineer Required by the GOVERNMENT of SIERRA LEONE, in the PUBLIC WORKS DEPARTMENT, for two tours of not less than 12 nor more than 18 months' continuous residential service. Salary £600 a year. Free quarters and passages, and liberal leave on full salary. Candidates, aged 29 to 35, should have served articles with a Member of the Royal Institute of British Architects, and have passed the examination qualifying for Associate Membership of that Institute, or possess the Diploma of some recognised College which is accepted by that Institute as exempting candidates from taking the examination of the Institute. Must be a first-class Draughtsman, capable of Designing and Carrying Out Buildings, Taking out Quantities, Preparing Details and Specifications, and must be competent to Execute Building Surveys, Set Out Buildings and Lay Out Roads. Other qualifications being equal, preference will be given to candidates who have had experience of the work of a Civil Engineer in the construction and carrying out of general public works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,190. 7596

Stock Verifier Required by the GOVERNMENT of TANGANYIKA TERRITORY for the RAILWAY DEPARTMENT for a tour of 24 to 30 months, with possible extension. Salary £350-£15-£400 a year, payable in the Territory in local currency, plus a temporary local allowance of 20 per cent. at present authorised up to the 31st December, 1924, when it will be subject to review. Outfit allowance of £30 on first appointment. Free quarters and passages. Liberal leave on full salary. Candidates, age 22 to 25, preferably unmarried, should have a good knowledge of railway stores nomenclature and of the classification of engineering and locomotive machinery, tools and plant.—Apply at once by letter, stating experience and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/13,212. 7251

G. R.

GOVERNMENT SURPLUS.

TRANSFORMERS,

LYING AT H.M. FACTORY, GRETNA.

For Sale by Public Tender

OWING TO THE URGENCY OF CLEARING THE AREA, WE ARE OFFERING FOR SALE BY TENDER A LARGE NUMBER OF TRANSFORMERS OF ALL SIZES UP TO 1000 K.V.A., 6600/440 VOLTS, 3-PHASE, 50 PERIODS.

CLOSING DATE OF TENDER HAS BEEN POSTPONED UNTIL DECEMBER 1st.

Particulars and forms of Tender from GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION, Abbey House, 2, Victoria-street, Westminster, S.W. Tel. No., Victoria 6040/4. Telegrams, "Colstrong, Sowest." 7521

City of Birmingham Education COMMITTEE

MUNICIPAL TECHNICAL SCHOOL.

HEAD OF ENGINEERING DEPARTMENT.

The Education Committee invite APPLICATIONS for APPOINTMENT to the POST of HEAD of the ENGINEERING DEPARTMENT of the MUNICIPAL TECHNICAL SCHOOL. The post is a full-time one and the salary scale is £850 per annum, rising, subject to satisfactory service, by annual increments of £30 to £900 per annum.

The above-named salary will be subject to a deduction of 5 per cent. in respect of the voluntary abatement of salaries, and also to the usual deduction of 5 per cent. in respect of contributions to the School Teachers' (Superannuation) Acts.

Particulars of the duties and conditions of the appointment, together with form of application, may be obtained from the Principal, Municipal Technical School, Suffolk-street, Birmingham, or from the undersigned.

Canvassing will be a disqualification.

P. D. INNES,
Chief Education Officer.

Education Office :
Margaret-street, Birmingham.
7th November, 1924. 7400

City of Liverpool.

BOILER SEATINGS.

The Corporation invite TENDERS for the CONSTRUCTION of SEATINGS for Three Lancashire Boilers at the Public Baths.

Specifications and other particulars may be obtained on application to the Engineer and Chief Superintendent, Baths Department, 75, Dale-street, on payment of Half-a-Guinea, which will be returned on receipt of a bona fide Tender.

Tenders must be enclosed and sealed up in the official envelope provided and delivered by letter post at the Town Clerk's Office not later than Noon on Wednesday, the 10th December, 1924.

The Corporation do not bind themselves to accept the lowest or any Tender.

WALTER MOON,
Town Clerk.

Liverpool, 18th November, 1924. 7566

The Engineer

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Locomotive Cylinder Performance—No. I.

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L.M. & S. Railway—Baltic Tank Locomotives.

The Magnus Effect.

The Motor Ship British Aviator.

A Track-laying Steam Tractor.

100 Years of British Railways—No. XXI.

PUBLIC NOTICES

City of Liverpool.

LANCASHIRE BOILERS.

The Corporation invite TENDERS for the CONSTRUCTION of THREE LANCASHIRE BOILERS at the Public Baths.

Specifications and other particulars may be obtained on application to the Engineer and Chief Superintendent, Baths Department, 75, Dale-street, on payment of One Guinea, which will be returned on receipt of a bona fide Tender.

Tenders must be enclosed and sealed up in the official envelope provided, and delivered by letter post at the Town Clerk's Office not later than Noon on Wednesday, the 10th December, 1924.

The Corporation do not bind themselves to accept the lowest or any Tender.

WALTER MOON.
Town Clerk.

Liverpool, 18th November, 1924. 7567

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for : GUN-METAL LAVATORY AND OTHER FITTINGS FOR CARRIAGES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 17th November, 1924.

A fee of 2s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Tuesday, 2nd December, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.

7547

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for : 25 OPEN and 75 COVERED GOODS BOGIE WAGONS, 5ft. 6in. gauge.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 21st November, 1924.

A fee of 2s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Wednesday, 3rd December, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.

7600

Hayfield Rural District Council.

MELLOR WATERWORKS.

The Hayfield Rural District Council invite TENDERS from Contractors for PROVIDING and LAYING about 7¼ MILES of 6in., 4in., and 3in. CAST IRON PIPES, with all necessary VALVES, HYDRANTS and APPARATUS, and also for CONSTRUCTING TWO MASS CONCRETE TANKS at Hayfield and Mellor respectively.

The drawings and specifications may be seen at the office of the Surveyor to the Council at Hayfield, Derbyshire, by previous appointment, or at the offices of the Engineers, Messrs. G. and F. W. Hodson, M. Inst. C.E., M. Cons. E., Bank Chambers, Loughborough, from whom copies of the schedule of quantities may be obtained on deposit of cheque for £5 5s., which will be refunded to contractors making a bona fide Tender on the return of the documents to the Engineers.

Sealed Tenders, on the form supplied, endorsed "Tender for Mellor Waterworks," are to be sent to the undersigned not later than Monday, the 15th day of December, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

J. R. BOWDEN,
Clerk to the Council.

Council Offices :
High-street, New Mills, via Stockport,
17th November, 1924. 7560

PUBLIC NOTICES

Bombay, Baroda, and Central India RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on FRIDAY, 5th December, TENDERS for the SUPPLY of—

CRUDE OIL ENGINE GENERATOR SETS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned). The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices, 91, Petty France,
Westminster, S.W. 1.
19th November, 1924. 7579

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. TENDERS for the SUPPLY of :—

(1) WHITE LEAD.
(2) BOLTS, NUTS, &c.
(3) LEATHER BUTTS, &c.
(4) PAINTS, &c.
(5) STEEL RAILS and FISH-PLATES.

For No. 1 on Wednesday, the 26th instant, and for Nos. 2, 3, 4, and 5 on Wednesday, the 3rd December proximo.

Copies of the specifications can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE,
Secretary.

73-76, King William-street, London, E.C. 4,
20th November, 1924. 7599

Great Northern Railway (Ireland).

The Directors are prepared to receive TENDERS for the SUPPLY of :—

BULL-HEAD RAILS,
FLAT-BOTTOM RAILS, and
FISH-PLATES (of British Standard Sections).
Also CAST IRON CHAIRS.

Specifications, drawings, and forms of Tender can be obtained from the undersigned.

Tenders, made out on forms supplied by the Company, should be delivered, under sealed cover, endorsed "Tender for Rails, &c.," not later than 10 a.m. on Friday, 12th December, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS,
Secretary.

Amiens-street Station, Dublin,
17th November, 1924. 7549

Herne Bay Urban District COUNCIL.

PROPOSED EXTENSION OF LANDING STAGE AT THE PIER HEAD IN FERRO-CONCRETE.

("HENNEBIQUE SYSTEM.")

TENDERS from such contracting firms only as are duly authorised to execute Ferro-concrete Works on the Hennebique System are hereby INVITED for the WORK required in the carrying out of the above-named contract.

Any such contractors desirous of tendering will be required to deposit the sum of £3 3s. with their application for forms of Tender, which sum will be returned upon receipt of a bona fide Tender.

Full particulars and forms of Tender can be obtained on and after the 24th instant from Messrs. L. G. Mouchel and Partners, Limited, 36/38, Victoria-street, Westminster, S.W. 1, or from Mr. B. J. Wormleighton, the Council's Engineer and Surveyor, Town Hall, Herne Bay.

Sealed Tenders, upon the form supplied, must be delivered at the office of the undersigned not later than first post on 8th December, and endorsed "Tender for Extension of Landing Stage."

The Council does not bind itself to accept the lowest or any Tender.

GEO. H. BEETENSON,
Clerk to the Council.

Clerk's Office :
Town Hall, Herne Bay,
18th November, 1924. 7525

PUBLIC NOTICES

In the High Court of Justice 1923 A. No. 501.
Chancery Division.
Mr. Justice Russell.
In the Matter of ALLDAYS and ONIONS Limited Great Western Works, Small Heath, Birmingham.

Mr. C. Herbert Smith, Chartered Accountant, Phœnix Chambers, 94, Colmore-row, Birmingham, the Receiver and Manager of the above-named Company INVITES OFFERS to reach him on or before the 6th day of December 1924 for the above very well-known and old-established BUSINESS as a GOING CONCERN. The Assets consist of :—

(1) The Trade Names, Trade Marks and Goodwill.
(2) The extensive and well-built Freehold Works and Land known as "Great Western Works" and situate in Sydenham-road, Small Heath, Birmingham.
(3) The well-built Building known as Great Western Hall and situate in Sydenham-road, Small Heath, Birmingham. Leasehold for 99 years from 22nd March, 1904, at a Ground Rent of £10 16s. This property comprises the Canteen and Caretaker's House.
(4) The Fixed Plant and Machinery.
(5) Loose Plant, Dies, Tools and Patterns.
(6) Office Furniture and Fittings.
(7) Motor Vehicles.
(8) Stock at cost or under, about £24,000.
(9) Book Debts (optional), about £15,000.

The principal business of the Company consists of the manufacture of Fans, Blowers, Forges, Power Hammers, Hearths, Furnaces, Bellows, Anvils, Vices, Cycles and Carrier Tricycles. It has been established over 200 years and has regularly carried out contracts for the War Office, Admiralty, G.P.O., and other Government Departments, Crown Agents for the Colonies, India Office, Home and Foreign Railways, and principal commercial firms at home and abroad. The business has been carried on by the Receiver and Manager under the direction of the Court for the past 18 months, during which period a trading profit has been made.

Full particulars may be obtained from the Receiver and Manager, Mr. C. Herbert Smith, F.C.A., of the firm of C. Herbert Smith and Russell, Chartered Accountants, Phœnix Chambers, 94, Colmore-row, Birmingham; or from Messrs. Evershed and Tomkinson, Solicitors, 35, Temple-row, Birmingham; or from Messrs. Stow, Preston and Lyttleton, Solicitors, 12, Lincoln's Inn-fields, London, W.C. 2. 7423

IRONFOUNDERS' AND STRUCTURAL ENGINEERS' BUSINESS FOR SALE BY PRIVATE BARGAIN.

The Subscribers are Prepared to receive OFFERS as a GOING CONCERN for the old-established BUSINESS (including GOODWILL, GROUND, BUILDINGS, PLANT, MACHINERY, STOCKS, &c.) carried on by JAMES ALLAN SENIOR and SON, Limited (in liquidation) at ELMBANK FOUNDRY and LAMBHILL IRONWORKS, GLASGOW.

The ELMBANK FOUNDRY, which is situated in FOSSIL-ROAD, GLASGOW, covers an area of fully 4 acres and contains Moulding, Dressing and Fitting Shops, Pattern Stores and Warehouses. The Foundry is capable of a large output of Rainwater Pipes, Gutters, Soil Pipes, &c., in addition to Ornamental Ironwork and Jobbing Work.

The LAMBHILL IRONWORKS cover an area of over 10 acres. These works are well equipped with modern machinery and tools the lay-out being on the most up-to-date lines for the economical production of all classes of Constructional Steel Work.

The LAMBHILL PLANT includes one 15-Ton and two 5-Ton Overhead Electric Cranes, Straightening, Cropping, Punching, Shearing, Planing, and Sawing Machines, as well as several Batteries of up-to-date Drills, Plate Rolls, and Pneumatic Riveting Plant.

Both works are conveniently situated for transport facilities.

In addition to an old-established home trade, the company has valuable export connections.

The works may be viewed by arrangement with the Subscribers. Offers, which may be for each business separately, must be lodged with the Subscribers not later than Friday, 5th December, 1924, at Twelve o'clock Noon.

Further particulars can be obtained on application to

LYALL K. HUTCHISON,
T. L. McLINTOCK,
Joint Liquidators.

100, West George-street, Glasgow,
3rd November, 1924. 7421

The Great Indian Peninsula RAILWAY COMPANY, 45, Copthall-avenue, London, E.C. 2, invite TENDERS for—

1. CLOTHS, &c. ..... Fee 10s.

Tenders are due by 11 a.m. on 2nd December, 1924. Tender forms obtainable at above address. Fees not returnable. 7563

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PUBLIC NOTICES

State Electricity Commission
OF VICTORIA.
Melbourne,
Victoria,
AUSTRALIA.

TENDERS are HEREBY INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place,
Strand,
LONDON, W.C. 2.

SPECIFICATION No. 23/1.—4600 V. TRANSFORMERS and SPARES.

CHARGE.—£1 1s., for the first three copies of tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth and any further copies will be supplied for the sum of 5s. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 12th January, 1925.

R. LIDDELOW,
Secretary.
7485

CONTRACT NO. 236.

The Directors of the Manchester Ship Canal Company
are prepared to receive TENDERS from experienced Contractors for the CONSTRUCTION and COMPLETION of TWO FIVE-STOREY TRANSIT SHEDS, Nos. 7 and 8; the EXTENSION of the GRAIN SUBWAY, with all ANCILLARY WORKS at No. 9 Dock, Manchester Docks.

Each shed is to be 450ft. in length, 110ft. in breadth, and five storeys in height. The sheds and the subway extension are to be of REINFORCED CONCRETE on existing foundations.

The drawings may be inspected and copies of the specification, bill of quantities and form of Tender can be obtained at the office of the Chief Engineer (Mr. H. A. Reed, M. Inst. C.E.), 41, Spring-gardens, Manchester, on and after the 24th day of November, 1924, on payment of a deposit of Ten Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, addressed to the undersigned and endorsed "Tender for Transit Sheds," should be delivered at this office on or before 10 a.m. on Monday, 22nd day of December, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

F. A. EYRE,
Secretary.

41, Spring gardens, Manchester,
19th November, 1924. 7574

TO BOLT MANUFACTURERS.

The Fylde Water Board Invite
TENDERS for the SUPPLY and DELIVERY at the Fylde Water Board Private Siding, Long Preston Station (near Hellifield), L.M. and S. Railway (Midland Section), of approximately 414 TONS MILD STEEL BOLTS, NUTS and WASHERS.

Specifications, quantities and conditions, &c., may be obtained from the undersigned, to whom Tenders must be submitted on or before 8th December, 1924.

The Board do not bind themselves to accept the lowest or any Tender.

GEO. F. ATKINSON,
Engineer.

Head Office:
Sefton-street, Blackpool.
November 17th, 1924. 7559

West Bromwich Union.
The Guardians invite TENDERS for various LAUNDRY MACHINES and APPLIANCES for the Laundry at Hallam House Institution, West Bromwich, in accordance with specification and plan prepared by Messrs. Edwards and Shaw, Consulting Engineers, 105, Colmore-row, Birmingham.

Conditions of contract may be seen at the undermentioned address and specification, plan, and form of Tender will be supplied by me upon application being made, accompanied by a deposit of £2 2s., between the 19th and 26th November.

The amount so deposited will be returned upon receipt of a bona fide Tender, sealed and endorsed "Tender for Laundry Machinery," and forwarded so as to reach me not later than 6th December, 1924.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
A. H. WARD,
Clerk.

22, Lombard-street, West Bromwich.
14th November, 1924. 7542

County Council of Middlesex
WANTED, on Temporary Engineering Staff, competent ASSISTANT to design and prepare working drawings of Reinforced Concrete Bridges.

Applications, stating age, experience, and salary required, to be forwarded to the undersigned not later than the 24th instant.

A. DRYLAND, M.I.C.E.,
County Engineer.

Guildhall, Westminster, S.W. 1. 7561

Portsmouth Water Company.
ENGINEERING ASSISTANT.

PERMANENT ENGINEERING ASSISTANT, about 25 to 30 years of age, REQUIRED by the Borough of Portsmouth Waterworks Company, as early as possible in the New Year. Applicants must have a good knowledge of waterworks design and construction, both practical and theoretical, and must also be good surveyors and draughtsmen. Previous personal experience in waterworks maintenance, including pumping machinery, would be an advantage, and an Associate Member of the Institution of Civil Engineers would be preferred. Salary £250 per annum, rising annually by £25 to £450.—Applications, on forms which will be provided on application to the ENGINEER and GENERAL MANAGER, Waterworks Company, Portsmouth, must be delivered not later than Friday, December 12th next. 7407

SITUATIONS OPEN

WANTED, for Large Chemical Works in the Midlands, ASSISTANT POWER ENGINEER, with technical knowledge and practical experience of E.H.T. and L.T. power supply, economical steam production, hydraulics, refrigeration, &c. Full particulars of experience, age, and salary required.—Address, 7540, The Engineer Office. 7540 A

A LARGE IRON and STEEL MANUFACTURING FIRM REQUIRES the SERVICES of a First-class ENGINEER, to Take Charge of its Plant and Drawing-office; preference will be given to a man accustomed to both modern and old plant, and who has had considerable experience in the rapid and efficient Repair of Breakages.—Applications, which would be treated in confidence, together with experience and salary required, should be addressed to 7582, The Engineer Office. 7582 A

ANALYST JUNIOR ASSISTANT REQUIRED in Engineering Laboratory; must be used to routine analysis.—Address, stating age and experience, 7554, The Engineer Office. 7554 A

ENGINEERING ASSISTANT WANTED. Must have good scientific and general engineering training and be competent to interview, exploit for orders and arrange for their execution. Man with good personal knowledge of industrial engineering firms preferred. Age not over 35.—Address, "SCIENTIFIC," William Porteous and Co., Advertising Agents, Glasgow P9794 A

ENGINEER WANTED to Superintend Manufacture of Small Self-measuring Oil Pumps. One with a knowledge of Sheet Metal Working preferred.—Write, stating full particulars of experience, salary, and age, Box 71, Selfs, Fleet-street, E.C. 4. 7544 A

SITUATIONS OPEN (continued)

ENGINEER REQUIRED for Tanganyika Territory, East Africa, retired Artificer, R.N., preferred. Must possess considerable experience of Semi-Diesel Oil Engines, otherwise application not considered; age not over 46.

Salary about £360 per annum, with gas servant allowance and free quarters; passage out and home.

State age and experience and enclose copies only of testimonials, which will not be returned. An agreement for three years must be signed.

Address, P9831, The Engineer Office. P9831 A

ENGINEER WANTED, with Practical Knowledge of design and construction of all classes of Gear-operated Rolling Shutters.—Address, P9815, The Engineer Office. P9815 A

ESTIMATING CLERK WANTED, Experienced in Boiler-house and Power-house Plant. State qualifications and details previous experience, also salary required.—Address, P9819 The Engineer Office. P9819 A

MANAGER WANTED, with Experience in general engineering and mechanical handling plant, also modern foundry practice. Must be capable designer. Applications treated in confidence.

Address, stating experience (in detail), age, and salary expected, P9821, The Engineer Office. P9821 A

PUBLICITY MANAGER, if Possible with Knowledge of Saw Mill Practice.—SPEAR and JACKSON, Ltd., Aetna Works, Sheffield. 7522 A

RATE FIXER REQUIRED for Midland District, familiar with small work and laying out sequence of operations and quick methods of production. State age, experience, and salary required.—Address, 7499, The Engineer Office. 7499 A

REPRESENTATIVE REQUIRED.—GENTLEMAN, with good connection amongst gas and chemical works, &c., in Scotland, REQUIRED, to increase existing connection of well-known Glasgow Engineering Firm and obtain orders for Structural Work, Gas Plant, Oil Storage and Refinery Plant, &c.—Apply in writing, stating qualifications and salary required, to MANN, JUDD, GORDON and CO., 142, St. Vincent-street, Glasgow. 7464 A

THE SERVICES of an ENGINEER, Thoroughly experienced in the design and erection of Reinforced Concrete, are REQUIRED. Candidates must hold a good degree, and should be about 25 years of age.—Written applications, with full particulars of training and experience, and stating age and salary required, to K. HOLST and CO., 1, Victoria-street, S.W. 1. 7559 A

WORKS MANAGER WANTED, Experienced in shop practice, organisation, and efficient production methods. State experience and qualifications.—Address, P9816, The Engineer Office. P9816 A

WOOLWICH POLYTECHNIC, S.E. 18.—WANTED, ENGINEERING WORKSHOP INSTRUCTOR for the Fitting and Machine Shop, and to Lecture on Workshop Processes. Age over thirty. Wide practical and recent Workshop Experience and good Technical knowledge essential. Salary according to L.C.C. scale.—For further particulars, apply PRINCIPAL. 7584 A

WANTED, CHIEF DRAUGHTSMAN, Capable organiser, experienced in Structure of Chemical Plant, to Take Charge of Small Staff. Must have estimating experience.—Address, stating experience, age, and salary required, 7548, The Engineer Office. 7548 A

WANTED, DRAUGHTSMAN, Accustomed to the design of High-lift Centrifugal Pumps and other Pumping Machinery. Permanent situation, but applicant must be conversant with above. State age, experience, salary, &c.—Address, 7576, The Engineer Office. 7576 A

WANTED, LEADING DRAUGHTSMAN or SECTION LEADER for Aircraft Work; must be capable and have initiative.—Address, 7494, The Engineer Office. 7494 A

CAPABLE DRAUGHTSMAN WANTED, Used to C. Brewery Work.—Apply by letter only, stating qualifications, to D. O., Messrs. H. PONTIFEX and SONS, Ltd., 43, Shoe lane, E.C. 4. 7527 A

DRAUGHTSMAN.—First-class MAN WANTED for special Machine, Jig and Tool Work on small repetition precision brass components. State experience in detail and salary required. Leeds district.—Address, 7571, The Engineer Office. 7571 A

DRAUGHTSMAN.—Good DRAUGHTSMAN REQUIRED TEMPORARILY in London Railway Engineer's Office.—Address, stating age, experience, and salary required, 7485, The Engineer Office. 7483 A

DRAUGHTSMAN.—WANTED IMMEDIATELY, a capable DRAUGHTSMAN, accustomed to Designing and Detailing Structural Steelwork; one used to Taking-off Quantities preferred.—Address, giving particulars of experience, salary required, and when at liberty, 7592, The Engineer Office. 7592 A

EXPERIENCED DRAUGHTSMEN REQUIRED (Senfors and Juniors). Aircraft or Ship experience preferred, but not essential.—State age, experience, and salary required to Box 779, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, E.C. 4. 7520 A

FIRST-CLASS DRAUGHTSMAN REQUIRED by well-established firm; must have experience in Design of Pumping Machinery for Waterworks and Sewage Works. This is a really good opening for a capable and energetic man. State full particulars, age and salary required.—Address, 7585, The Engineer Office. 7585 A

HEAD DRAUGHTSMAN WANTED for Lancashire heavy general engineering; able modernise design. State special lines and indicate salary.—Address, 7383, The Engineer Office. 7383 A

INTERNAL COMBUSTION ENGINES.—Experienced DRAUGHTSMAN DESIGNER WANTED, must have sound knowledge of theoretical mechanics and latest practice in Diesel design and operation.—Apply by letter, stating qualifications, experience, and salary required, P9827, The Engineer Office. P9827 A

SMART JUNIOR DRAUGHTSMAN WANTED; must have good experience of Petrol and Paraffin Engine Design; knowledge of Air Compressor desirable. State age, experience and salary required.—Address, 7588, The Engineer Office. 7588 A

TANGYES LIMITED REQUIRE a Thoroughly qualified LEADING DRAUGHTSMAN for their Hydraulic and Lifting Tackle Department. Applications, which will be treated in strict confidence, should state full experience, age and salary required.—Address to CHIEF ENGINEER, TANGYES LIMITED, Cornwall Works, Birmingham. 7586 A

TRANSFORMER DRAUGHTSMAN.—APPLICATIONS are REQUESTED for the APPOINTMENT of a TRANSFORMER DRAUGHTSMAN with well-known British firm of electrical engineers.

Applicants must have had first-class experience in the design and manufacture of Large High-tension Transformers.

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Woolwich Arsenal.

FROM the remarks made at a meeting last week of the Association of British Chambers of Commerce held in London, it might be inferred that the lengthy agitation aiming at the industrial development of Woolwich and its release from all but complete dependence upon the production of war material was at last about to bear considerable fruit. It was stated at the meeting referred to that the Woolwich Chamber of Commerce had persuaded the Government to release certain of its workshops and parts of its river frontage for the use of private enterprise. It would appear, however, that there is no authority for the suggestion that may be read into this statement that the Government is about to dispose of part of Woolwich Arsenal. Short of that, however, it is interesting to note that the Government is considering whether it can release a portion of the land attached to the Arsenal. Last June, it may be recalled, it decided to give up using Woolwich Dockyard as an ordnance depôt. In accordance with that decision a small portion of the Dockyard has already been let on a temporary basis to a private business firm.

Southern Railway Developments.

SPEAKING at a luncheon given last week to celebrate the inauguration of a new Pullman coach train service between Victoria and Dover, Brigadier-General Baring, chairman of the Southern Railway, gave some details of the development work in progress on that line. The company's Continental services were, he said, growing at a good rate. The total number of passengers carried during the first nine months of this year amounted to some 1,500,000. This growth called for increased accommodation on the cross-Channel steamers, and to provide such accommodation the company had placed an order at a cost of £190,000 for a new steamer, a feature of which would be the increased amount of shelter deck space provided. It was hoped that the new vessel would be in commission by the beginning of July next year. Dealing with improvements elsewhere on the system, General Baring remarked that very considerable alterations were to be made at the two Dover stations at a cost of £320,000, and that similar station improvement works were about to be begun at Victoria, Wimbledon, Ramsgate, and Margate. As regards the electrification work now in hand, he said that by February it was hoped to have the Victoria-Coulsdon and Victoria-Sutton sections at work under the new conditions. On the South-Eastern branch it was anticipated that the electrified line between London and Orpington would be opened by July 1st and that the whole of the electric system would be at work by the beginning of 1926.

Another Engineering Club.

WITH the opening in Wolverhampton on Wednesday of the new Engineering and Scientific Club this country is provided with three institutions of the kind, the other two being, of course, in London and Manchester. The scheme has been under consideration in Wolverhampton for some time past, but it was only recently that appropriate housing accommodation for a club was secured. The building known as the Old Post Office in Queen-street has been fitted up and includes a large lecture room. The club starts with a good backing of most of the leading firms of the district and several prominent public men, while it had the distinction of being opened by Sir John Dewrance, past president of the Institution of Mechanical Engineers. Although it is intended that the Club should be primarily a social organisation, it is hoped that it may provide a home for such local bodies as the Engineering Society and the Civil, Mechanical, Electrical and Automobile Engineers.

The American Battleship Incident.

A SOMEWHAT theatrical attempt to defeat the operation of the Naval Armaments Treaty was made last week by Mr. W. B. Shearer, an American writer who has distinguished himself by his persistent hostility to this compact. He sought an injunction in the Washington courts to restrain Mr. Wilbur, Secretary of the Navy, from destroying the battleship Washington—one of the ships condemned under the Treaty—on the grounds that the agreement had not been completely ratified, and that Great Britain, in particular, had been remiss in fulfilling her obligations with respect to the scrapping of ships. As was to be expected, the Supreme Court of the District of Columbia dismissed the application. Mr. Wilbur declined to enter into the allegations made against Great Britain, which he termed "impertinent" and "immaterial." The Washington has therefore been towed out to sea, where it will be used as a target for aerial bombing attack and gun practice. This vessel was launched in 1921 as the fourth unit of the "Maryland" class, and if completed would have displaced 32,600 tons. As she embodies the most modern principles of defence, valuable experience should be derived from the tests to which she is being subjected. The firm action taken by Mr. Wilbur in this matter suggests that the Navy Department has no sympathy with the propaganda which is being waged against the limitation treaty in a section of the American Press. It is reported that Congress will shortly inquire into the question of relative naval strength, in order to clear up the confusion created in the public mind by the misstatements of self-styled "experts," who appear to have more political animus than technical knowledge.

Wages in the Electricity Supply Industry.

AT a recent meeting held in London the National Joint Council for the electricity supply industry decided to act upon the recommendations of the tribunal with regard to the claim of the trade unions for a general advance of ten shillings a week in wages throughout the industry. The tribunal came to the conclusion that while no case had been made out for a national advance in wages, the Joint District Councils should reconsider the rates of pay in each area. It was also recommended that if any District Council failed to reach agreement the matter should be referred to the National Joint Council and, if necessary, the tribunal should be reconstituted to determine any case in which there was still failure to reach agreement. On the same day as this meeting was held there was a preliminary conference of the executives of the electrical trade unions and the workers' representatives on the National and Area Councils. Opposition to the acceptance of the tribunal's report came mainly from London and the home counties. On the whole, however, the unions were not opposed to district wage settlements, and it was finally decided that the workers' side of the Joint Council should be left free to negotiate. The only part of the tribunal's report that has not been adopted is that relating to the constitution of the tribunal in the event of the National Council being unable to reach a conclusion on a disagreement in a given area.

The Wages Dispute at Barking.

THE wages dispute at the new Barking (London) power station, which arose over the demand for the employees of a well-known Tyneside firm to be paid the London district rates, has taken a serious turn. At the conclusion of a meeting of shop stewards held last Monday Mr. Webb, the London district secretary of the Electrical Trades Union, said that the Standing Committee of No. 10 Area Council had decided to call a special meeting of the full Industrial Council at the Marylebone Town Hall. At the meeting of the shop stewards it was decided to ask the executives of the various unions concerned immediately to convene a joint conference to take the matter up with the Engineering Employers' Federation, and in the event of no settlement being reached to take uniform and co-ordinated strike action in all the London power stations. This conference will apparently be held at the end of this week or at the beginning of next, but much will depend on the meeting of the Industrial Council, which is to be held to-day (Friday). If strike action be decided upon at the London power stations seven days' notice will be given before the strike begins.

British Industries Fair.

IN view of the probable reopening of the British Empire Exhibition in 1925, it has been decided to suspend the London Section of the British Industries Fair, which would otherwise have been held from February 16th to 27th next. The Birmingham Section of the Fair will, however, be held as usual, and as a special measure for 1925 only the Birmingham Chamber of Commerce has undertaken to organise sections in its Fair for those exhibitors who have hitherto shown in London, provided that the demand for space ensures the adequate representation of the industries concerned. The Department of Overseas Trade, it is stated, expects to resume the series of British Industries Fairs in London in 1926.

The New British Airships.

FURTHER technical particulars are now available regarding the new British airship R 101, which is to be built by the Air Ministry at the Cardington Works, near Bedford. Her gas capacity of 5,000,000 cubic feet will be provided for in a hull 720ft. in length, and her overall height will be 140ft. In her construction special attention will be given to the fact that she will be required to operate in tropical climates during part of her regular voyages to India. The fabric of her gas bags will be of a special but unspecified material, the propellers will be of steel, and the main part of the framework will be of stainless steel. The vessel will be propelled by seven 600 horse-power engines, designed to use heavy oil fuel in place of petrol. At full power a maximum speed of about 70 miles an hour will be achieved, on a consumption of 1750 lb. of fuel per hour. A gross lift of 155 tons will be developed, of which 75 tons will be available for fuel, ballast, passengers, goods and stores. On a commercial run of 2500 miles—that is to say, from England to Egypt, where presumably a re-fuelling station would be established—20 tons would be available for passengers and goods. The vessel is not necessarily to be built for commercial purposes, but if it is so adapted, it should provide accommodation for 100 passengers, with two-berth sleeping cabins arranged on a deck separate from that containing the living quarters and public rooms. It is anticipated that the R 101 will be ready for her first voyage to India by the beginning of 1927. Meanwhile, the R 33 is being equipped for experimental purposes, and the R 36 is being reconditioned at Pulham for trial voyages to the Middle East.

A New Type of Sailing Ship.

ACCORDING to the Berlin correspondent of *Lloyd's List and Shipping Gazette*, the Hamburg-American Line is so fully convinced of the importance of Herr Anton Flettner's new type of sailing ship, that it has decided to lay down at once ten cargo vessels of 10,000 tons each, to be propelled by Flettner "rotors." These new vessels, it is stated, will be used on the company's Asiatic routes. According to the same correspondent, Herr Flettner estimates that on a voyage from Hamburg to Rio his system would save 50 per cent. of the oil fuel costs of an ordinary vessel—presumably of the motor type—while on the Hamburg–New York route the saving would amount to 35 or 40 per cent. A licence fee, amounting to 10 per cent. of the tonnage value of the ships on which the system is installed, is being charged for the use of the patents. Herr Flettner maintains that the cost of the licence will be repaid within a year's use of the ship. All the statements in this paragraph must be accepted with reserve, as we have not confirmed them. Elsewhere in this issue, however, a short article will be found giving an account of the so-called Magnus effect on which the "rotor" system of propulsion is based.

The New Tweed Bridge.

THE settlement of the contract for the construction of the new bridge across the Tweed at Berwick marks another step towards a great improvement in the road transport facilities between England and Scotland; but it will probably be two and a-half years before the structure is ready for traffic. The northern approach to the bridge will be through Golden-square, in Berwick, while on the south side it will be from West End, Tweedmouth, and the construction of these approaches will result in the clearing away of a large amount of slum property. The bridge itself is to be of reinforced concrete, and will be noteworthy through including the longest span of that type in the country. There are to be four arched spans of gradually decreasing width and height, as the Berwick end is left. The river channel is on the north side, and there the span will be 361ft. 6in. The following spans will be 285ft., 248ft. and 167ft. long respectively. The overall length of the bridge is to be 1405ft., and the total width 46ft., allowing room for a 30ft. roadway. The headroom under the main arch will be 46ft. at high water. Each of the arches will comprise four ribs, and those of the main span will be 10ft. 6in. deep at the springing and 7ft. deep at the crown. The width of the two inner ribs is to be 5ft. and that of the outside ribs 3ft. 6in. The decking will be carried by vertical columns springing from the arch ribs. The designs have been based on the assumption that the bridge must be capable of bearing a unit load consisting of a moving engine and trailers weighing 90 tons and covering an area of 70ft. by 10ft. The contract for the bridge has been awarded to Holloway Bros., of London and Newcastle, and the cost of the whole scheme is put at £160,000.

Railway Crisis Threatening.

THE acting secretary of the Associated Society of Locomotive Engineers and Firemen has intimated the possibility of a railway crisis arising early next year. From the beginning of the third full pay week in January the mileage basis for the payment of drivers and firemen will, in accordance with the award of the National Wages Board in December, 1923, be raised from 120 to 150 miles a day, that is to say, for every 15 miles above 150 an hour's payment will be made. It is intimated that if this increase in the mileage basis is put into force the locomotive men will institute a national strike.

Highway Engineering.

SPEAKING at a banquet given in London by the Worshipful Company of Paviors, the Master, Mr. E. G. Price, announced that he and his wardens had been pressing forward a proposal for the foundation of a Chair of Highway Engineering at London University. Sir Henry Maybury, Director-General of Roads, at the Ministry of Transport, remarked that this country was now spending £50,000,000 a year on highways and bridges. He thought that it was necessary that the surveyors and others responsible for carrying out the work should be better paid than some of them were at present, and that they should be better equipped for their duties. The last-named end would, he held, be facilitated by the foundation of the proposed Chair.

Locomotive Cylinder Performance.

By E. C. POULTNEY, O.B.E.

No. I.

In THE ENGINEER of February 22nd and 29th last the writer discussed results obtained on the locomotive testing plant at Altoona, Pa., in connection with the Pennsylvania express locomotives K 2 sa and E 6 s. In those articles only the boiler performance of the two locomotives was dealt with, and it is now proposed to give the test results appertaining to the engines of the same locomotives. In the near future it is hoped to deal with the combined boiler and engine performance, that is, with the locomotives as whole units.

The information given in the test reports (Bulletins 18 and 21) is of a most comprehensive character, and

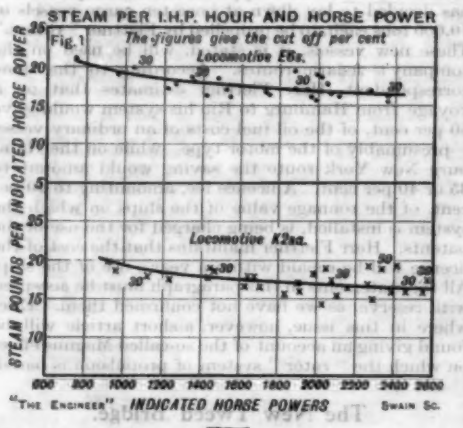

STEAM PER I.H.P. HOUR AND HORSE POWER
Fig. 1
The figures give the cut off per cent
Locomotive E6s.
Locomotive K2sa.
STEAM POUNDS PER INDICATED HORSE POWER
"THE ENGINEER" INDICATED HORSE POWERS
SWAIN SC.

FIG. 1

in the preparation of this article an endeavour has been made to select only those characteristics of the engine performance which are probably of the most practical interest.

General Description of Engines.

In addition to the two engines above mentioned, certain results obtained from tests made with others have been added in special instances, notably those made with "Atlantic" type locomotive No. 5075, Class "E 6," working with saturated steam; but except for the addition of the superheater similar to E 6 s, No. 89, operating with superheated steam.

The following list gives the principal dimensions and leading particulars of the engines for the two locomotives K 2 sa and E 6 s.

Engine Particulars.

	K 2 sa, No. 877.	E 6 s, No. 89.
Cylinders, diameter and stroke, inches	24 by 26	22 by 26
Valves, kind and size	Piston, 16in.	Piston, 16in.
Maximum travel, inches	6.88	6.5*
Outside lap	1.34	1.35*
Exhaust lap	.22	.41*
Exhaust lead in full gear—		
Steam ports, width	1 11/16	2 1/4
Valve liners, inches diameter	16	14
Exhaust ports, width	—	3
Valve motion	Walschaerts	Walschaerts
Valve motion operation	Lever in notched sector	
Driving wheels diameter, inches	80	80
Steam pressure	205	205
Steam pipes	Inside	Outside

* These particulars are for the R.H. engines in each case. For the L.H. side there are very slight differences. "Inside admission" piston valves in each case.

The piston valves for each of the engines are fitted with "L" type rings. The spiders or ends of the valves carrying the rings are connected together by tubing 10in. outside diameter, to which the ends are riveted. The ring followers are threaded over the valve spindles and the whole unit held together by nuts in the usual manner.

The Atlantic engine, cylinders 22in. by 26in., is fitted with extended piston-rods, which are supported by supplementary slides moving on suitable guides with covers to protect the rubbing surfaces from dust. The Pacific, cylinders 24in. by 26in., is not so fitted. The ordinary type of two-bar crosshead guides are fitted in both engines and the connecting-rod big ends are of the open type, the brasses being held in position by the usual type of cotter. The connecting and coupling rods are of fluted section, the latter having the ordinary type of solid bushed ends. The journals for the coupled wheels in the case of the Atlantic are 9½in. by 15in., whilst for the Pacific they are 10½in. by 15in. The weight on the coupled axles for the Atlantic is 141,000 lb. and for the Pacific 179,900 lb., so that the average journal pressures per square inch of projected areas are 247 lb. and 268 lb. respectively.

Engine Test Conditions.

The principal conditions controlling the performance of the engines are given in Table I. Each locomotive was tested at speeds varying from 120 to 360 revolutions per minute. The nominal cut-offs at each speed were from 20 to 50 per cent. of the stroke. The number of tests made at each speed and cut-off is given in the columns under the respective cut-offs, and the additional figures, in brackets, are the actual cut-offs as shown by an inspection of the indicator cards. The main tests of each locomotive were made with the throttle wide open.

The "Atlantic" type locomotive, in addition to the tests made with a full throttle, was given six tests, two each at 200, 240, and 280 revolutions per minute, with the throttle partially closed, and at nominal cut-offs of 30 and 40 per cent. respectively.

The selected speeds for each test were kept constant throughout each trial. The speed being constantly watched by means of a tachometer, and the water pressure in the friction brakes on the supporting wheel axles was kept regulated through the adjustment of a hand-controlled valve. The reading of the tachometer was checked every ten minutes by noting the number of revolutions as indicated by a mechanical counter.

Cut-off.

Referring to Table I., it will be seen that there is in all cases a difference between the cut-off as shown by the indicator diagrams and by the position of the reverse lever in the sector. On this matter the test report dealing with the 4–4–2 engine, Class "E 6 s," Bulletin 21, states that this irregularity is doubtless due in part to the difficulty in measuring the cut-off from either the locomotive or from the indicator diagrams, but probably in a large part to the change in cut-off caused by actual variation due to difference in speed; that is to say, the increase in cut-off for a given position of the reverse lever as the speed is increased must be due to the lack of rigidity in connections between the catch of the reverse lever and the valve. It will be observed that the differences are small at low speeds, but increase with increasing speed.

TABLE I.—*Locomotive Test Conditions, Full Throttle.*

	Revolutions per minute.	Nominal cut-off per cent. of stroke. 20	25	30	35	40	45	50
K 2 sa	120	1 (20.1)	1 (21.4)	1 (28.4)	— (35.2)	2 (40.6) (39.6)	—	—
	160	—	1 (23.3)	1 (30.2)	2 (33.4)	—	1 (44.9)	1 (49.3)
	200	1 (22.7)	1 (29.6)	—	1 (33.8)	—	—	2 (50.6)
	240	1 (24.8)	1 (28.0)	1 (33.9)	1 (36.3)	—	—	— (50.9)
	280	1 (24.8)	1 (29.8)	1 (35.4)	1 (35.7)	—	—	1 (50.4)
	320	1 (23.5)	1 (30.6)	1 (35.1)	—	—	—	—
	360	1	1	1 (38.5)	—	—	—	—
F 6 s	120	1 (21.0)	1 (27.8)	1 (30.2)	—	1 (42.8)	—	—
	160	—	1 (29.4)	1 (32.0)	1 (36.2)	—	—	1 (49.8)
	200	1 (25.6)	1 (30.8)	—	1 (37.3)	—	—	2 (50.7)
	240	1 (25.6)	1 (32.9)	1 (35.7)	—	—	—	(51.7)
	280	1 (25.6)	1 (32.8)	1 (36.3)	1 (41.2)	—	—	—
	320	2 (29.0) (32.7)	1 (36.6)	—	—	—	—	—
	360	1 (29.5)	1 (40.6)	1 (38.5)	—	—	—	—
				Partial Throttle Tests.				
E 6 s	200	—	—	1	—	1	—	—
	240	—	—	1	—	1	—	—
	280	—	—	1	—	1	—	—

In addition to the above E 6 s was given a test at 38 per cent. cut-off and at 240 revolutions.

Water Rate and Power.

The consumption of superheated steam in relation to the indicated power is shown by Fig. 1 for both engines. It is of interest to note that the mean lines drawn correspond in the case of both engines to the results obtained when working at about 30 per cent. cut-off; furthermore, as a rule, points above this line which show a higher steam rate correspond to a longer cut-off, whilst those below indicating a less steam rate are the results obtained at cut-offs less than 30 per cent.

The outstanding facts brought into prominence by these curves are the remarkably low steam consumptions and the uniformity in the weight of steam required throughout a considerable range of power output. In the case of the K 2 sa engine, which has 24in. by 26in. cylinders, the steam rate varied from 19.73 lb. at 931.49 indicated horse-power to 16.63 lb. at 2573 indicated horse-power, the maximum attained, whilst the least steam consumption recorded was as little as 14.6 lb. when developing 2290 indicated horse-power at 320 revolutions, 74 miles per hour, with a nominal cut-off of 25 per cent. Within the limits of 1400 to 2200 indicated horse-power the average steam rate only varied between 18 lb. and 17 lb. The results for both engines showed that the lowest steam consumptions were those obtained at the higher rates of power developed.

Superheat and Power.

The superheat in the branch pipes plotted against indicated horse-power is shown for both engines in Fig. 2. The diagram seems to indicate a straight line relation between these two quantities. In the case of both of the engines an increase in power is followed

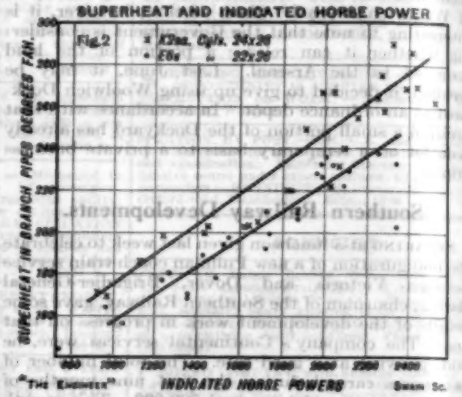


FIG. 2

by an increase in superheat, and the superheater of the K 2 sa locomotive furnishes higher steam temperatures than that fitted to the smaller E 6 s, though in each case the superheater heating surface bears practically the same relationship to the total boiler heating surfaces. On the other hand, the superheating surface is about 43 per cent. greater and the total combined heating surface (water side of tubes and flues) is 27 per cent. greater on the Pacific than on the Atlantic engine. With an increase in power comes an increase in evaporation and a higher superheat, both of which are caused by an increase in the draught owing to the greater volume of the exhaust, which in the case of the Pacific, with its larger boiler and 24in. by 26in. cylinders, is greater than in the Atlantic, with its 22in. by 26in. cylinders.

To state definitely that superheat follows indicated horse-power entirely would not, however, be correct, for superheat depends upon other conditions,

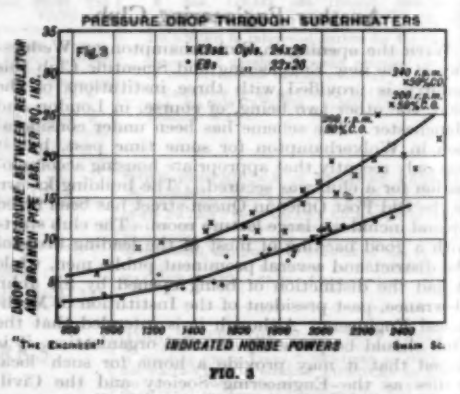

PRESSURE DROP THROUGH SUPERHEATERS
Fig. 3
K3sa. Cyls. 24x26
E6s " 22x26
DROP IN PRESSURE BETWEEN REGULATOR AND BRANCH PIPE LBS. PER SQ. INCH
"THE ENGINEER" INDICATED HORSE POWERS
SWAIN SC.

FIG. 3

namely, the size of the superheater, flue tube temperature and the steam pressure. But, since it has been shown that for a given superheater of the flue tube or Schmidt type, increase in superheat follows the rate of evaporation, and that increase in evaporation gives an increase in the power developed, it is right to suppose that an increase in power would bring about an increase in superheat, which supposition is shown to be true when superheat is plotted directly against indicated horse-power, as has been done in Fig. 2.

It can now also be seen that for a given power output a given superheat can be attained, and that the higher the power developed, the greater will be the superheat. Hence, however desirable a higher superheat may be at a lower power output, it cannot be had with a given size and arrangement of superheater of the kind under consideration. It is, however, probable that this characteristic of the Schmidt superheater is not, in practice, a disadvantage, because at intermediate powers, such as those obtaining at comparatively low degrees of superheat, boiler conditions are such as are conducive to fairly economical steaming. The advantage, however, of the higher steam temperatures, and hence steam volume,

rendered available at higher power output when the boiler is being forced to greater rates of evaporation, and consequently operating at less efficiency, is apparent. It constitutes an advantage which, in practice, is one of the most valuable features of a superheater locomotive, extending as it does materially the range of power through which such an engine may be operated.

Pressure Drop and Power.

The rate of pressure drop, or the throttling action

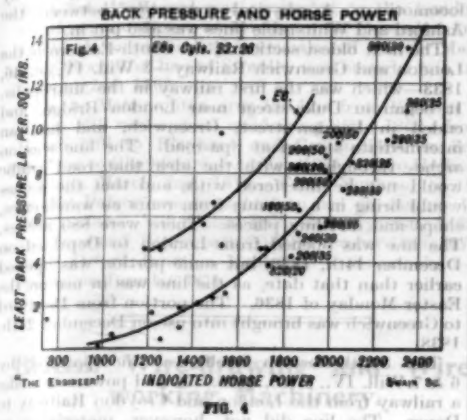


FIG. 4

of the superheater, the steam passages and ports, compared with the indicated horse-power, is indicated by Fig. 3, where the branch pipe or smoke box steam pipe pressures for each test have been plotted against the indicated horse-powers. The upper curve relates to the "Pacific" type, and the lower to the "Atlantic" locomotive. The larger superheater having at the same time the longer elements, combined with larger cylinders, shows the greatest loss in pressure between the throttle valve and the smoke-box steam pipes. The line is very slightly curved, especially in the case of the "Atlantic" locomotive, and it would be still straighter for the "Pacific" if the three points showing the greatest pressure drops were disregarded, and since they appertain to tests at a longer cut-off than would generally be used at the speeds maintained during these particular tests, it is probable that they might safely be omitted.

Back Pressure and Power and Superheated and Saturated Steam Compared.

It has been shown that there is a nearly uniform pressure loss in the steam chests as the power increases. This and the back pressure influence the mean forward pressure on the pistons for any given speed and rate of cut off. Fig. 4 shows how the least back pressure varies with the power output.

The curves given show the average least back pressures plotted for each test against indicated horse-power. The figures on the diagram give the speed—revolutions per minute—and nominal cut-off for each of the tests, and show the corresponding amount of the least back pressure at the higher power tests. They indicate the conditions of speed and cut-off for any given degree of least back pressure, and an inspection of the pressures shown, together with the test conditions, shows, as would be expected, that any method of operation which increases the amount of steam admitted to the cylinders increases the back pressure, and that for a given cut-off an increase in speed—revolutions per minute—will also bring about an increase in the least back pressure. Both these conditions increase the rate of power developed, so that it can be fairly stated that an increase in power, however obtained, will be accompanied by an increase of the least back pressure.

While it is true that the action of the blast is dependent on the back pressure, it is true also that, inasmuch as back pressure influences the mean forward pressure on the pistons, it must be important to reduce back pressure, especially if the increased power that would result is desired. In this connection, it is interesting to note how a change from saturated to superheated steam will affect the back pressure conditions when no other alterations are made save the fitting of the superheater. Such results are fairly well given in Fig. 4, where the results obtained from engine E 6 working with saturated steam are also plotted. Unfortunately, there are only seven tests for E 6, against twenty-seven for E 6 s. The curve for the latter engine is therefore more definitely located, but as the back pressure for E 6 is in all cases greater than in the E 6 s, working with superheated steam, and as the results for E 6 plot in a nearly parallel line, the curve for this engine has been so drawn, though it would seem that for the engine E 6 there may be a more rapid increase in the back pressure as the power advances. The inference is that superheated steam exhausts with about half the least back pressure of saturated steam used in the same design and size of cylinders. The gain from this cause alone by substituting superheated for saturated steam is therefore considerable.

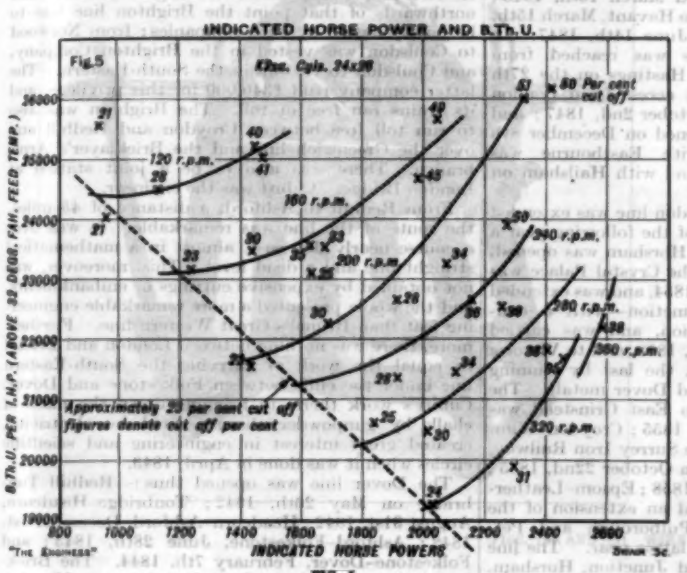

INDICATED HORSE POWER AND B.Th.U.
Fig.5
K2sa. Cyls. 24x26
B.Th.U. PER I.H.P. (ABOVE 32 DEGS. FAH. FEED TEMP.)
Approximately 20 per cent cut off
figures denote cut off per cent
INDICATED HORSE POWERS
"The Engineer"

FIG. 5

Cut-off Speed and Heat Consumption.

Fig. 5 shows in graphic form the relation between the power developed and the heat consumption in B.Th.U. above 32 deg. feed-water temperature. The full lines give this information for each speed at which the tests were made, drawn through points representing the actual cut-offs as obtained from the indicator diagrams. The effect of speed on the heat consumption per indicated horse-power is very strikingly brought out by this figure, as is also the effect of lengthening the cut-off. The lowest speed is the least economical, whilst the highest gives the best results and the shorter cut-offs give results at all speeds. For in heat consumption, the most economical this particular engine, namely, K 2 sa, having 24in. by 26in. cylinders, and for powers between 1000 and 2000 indicated horse-power, approximately 20 per cent. cut-off gives the best results.

Table II.—*Cylinder Dimensions and Steam Rate, 22in. and 24in. Cylinders Compared.*

Engine.	Revs. per minute.	Actual cut-off.	Steam. Boiler pressure.	Steam. Branch pipe pressure.	Steam. Pressure drop.	Steam. Superheat, deg. Fah.	Lb. per I.H.P.	Indicated horse-power.	Cylinder sizes.
E 6 s	320	29.0	195.0	189.5	5.5	192.3	17.4	1721.4	22in. × 26in.
	320	32.7	205.0	196.5	8.5	199.8	16.7	1741.5	
K 2 sa	320	23.5	204.2	192.4	11.9	222.7	14.6	2033.1	24in. × 26in.
	320	30.6	205.9	187.3	18.6	258.1	14.9	2290.5	
	320	35.1	204.4	183.3	11.1	270.3	16.2	2457.9	

Larger cylinders give a better steam rate and develop higher powers.
The pressure drop in the branch pipe is greater, so also is the temperature of the superheated steam supplied to the engines.

From this figure, it is seen that the following conclusions may be made:—

(*a*) For a given cut-off, an increase in speed increases the power and decreases the heat consumption per unit of power developed.

(*b*) For any given speed an increase in cut-off increases the power, but also increases the heat necessary per unit of power.

(*c*) The highest powers, *i.e.*, indicated horse-power, are always obtained at the higher rates of speed.

(*d*) Lengthening the cut-off at the higher speeds, whilst increasing the power developed also increases the heat required per unit of power more rapidly than is the case at the lower speeds.

Fig. 5, besides providing means for observing the effect of speed and cut-off upon steam consumption, also enables a decision to be made as to the probable effect of an increase in cylinder dimensions, if such should for any reason appear desirable.

From the diagram, the indications are that for any power above 1000 indicated horse-power at any speed 20 per cent. is more economical than any longer cut-off.

If a line be drawn as indicated by that shown dotted passing through points denoting a 23 per cent. cut-off, it will be seen that it inclines downwards to the right, indicating that at as short a cut-off as 23 per cent. the steam consumption decreases as the indicated horse-power increases. This being true for any given speed and any given power with given cylinders, then the economy should be no less with larger cylinders at the same speed and cut-off, and consequently at a higher indicated power. On the contrary, the economy might be expected to be greater, since with higher power comes higher superheat. Fig. 2 shows this latter inference to be true.

Table II., compiled from the K 2 sa and E 6 s tests, shows how at approximately equal rates of actual cut-off and at equal speeds, the 24in. cylinders of the 4–6–2 type Class "K 2 sa" engine gave the better results as to the steam rate, while at the same time developing higher powers.

When considering, then, any change which may be necessary in cylinder dimensions, if any given locomotive is converted to use superheated in place of saturated steam, it will be seen from the above discussion that if the existing cylinders prove, through the introduction of superheating, too small to utilise the resulting steam supply, larger cylinders may be fitted, which will give a higher power output and an improved water rate for the indicated horse-power developed.

One Hundred Years of British Railways.

No. XXI.*

PART II.—THE FIRST HALF CENTURY.

THE SOUTHERN RAILWAYS.

London and South-Western.

The Bodmin and Wadebridge Railway is the oldest portion of the London and South-Western. It was sanctioned by 2 & 3 Will. IV., c. 47, 1832, being part of a scheme advocated by William James—who, by the way, lived for some years at Bodmin and died there on March 10th, 1837—for a railway between the English Channel at Fowey and the North Cornish coast at Padstow, and was opened on July 1st, 1834. Although many miles distant from its activities the Bodmin and Wadebridge Railway was being worked by the London and South-Western in the late 'forties, but without parliamentary sanction. Under 28 & 29 Vic., c. 370, 1865, the line was modernised, and in 1886 was acquired by the London and South-Western. One of the original coaches and some of the track stand inside Waterloo Station.

The origin of the London and South-Western Railway lay in the London and Southampton Railway—4 & 5 Will. IV., c. 88, 1834—which was opened thus: Nine Elms–Woking, May 21st, 1838; Woking–Winchfield, September 24th, 1838; Winchfield–Basingstoke and Winchester–Southampton, June 10th, 1839; Basingstoke–Winchester, May 11th, 1840. The powers for the line from Bishopstoke to Gosport authorised the company to bear its present name. It was opened on November 29th, 1841, but owing to the failure of a tunnel at Fareham it had to be temporarily closed four days later, to be re-opened on February 7th, 1842.

In 1844, when the Surrey Iron Railway—see Article No. IV.—was sold, the London and South-Western, without any parliamentary powers, purchased it. As it had no use for the line it was resold for the same figure to the London, Brighton and South Coast Railway. The Guildford Junction Railway, from Woking to Guildford, was opened on May 5th, 1845. It was intended to equip this line with Prosser's patent railway—described in The Engineer of January, 1900—as demonstrated on Wimbledon Common. The purchase money for the Guildford line included the sum of £20,000 to be paid to Prosser as compensation for not using his railway. On July 5th, 1846, a connection to Richmond from Falcon Junction, Clapham Junction, was made, and on March 1st, 1847, Salisbury was reached from Bishopstoke—now known as Eastleigh—and on May 1st, 1847, Dorchester from Southampton. The Chertsey branch was opened on February 14th, 1848.

On July 11th, 1848, the London terminus was changed to one in the Westminster Bridge-road which, on opening, was given the name of Waterloo, owing to its proximity to Rennie's bridge. On the 22nd of the following month the Windsor line was extended from Richmond to Datchet and was completed on December 1st, 1849. The Portsmouth line of the

* No. XX. appeared November 14th.

London and Brighton—opened on June 14th, 1847—was joined by a branch from Fareham to Cosham on October 1st, 1848, and, in anticipation of the opening of the Reading, Guildford and Reigate Railway—later the property of the South-Eastern—the line from Ash to Guildford and thence to Shalford Junction, was brought into use on August 20th, 1849. The Ash portion was extended to Farnham on October 1st following, and on that date the London and South-Western reached Godalming. The line from Farnham to Alton was opened on July 28th, 1852. Meanwhile the Hampton Court branch had been brought into use on February 1st, 1849, and what was called, and is still known as the Hounslow loop—from Barnes to Feltham—was opened on September 1st, 1849.

Nine years before the London and South-Western reached Exeter it opened, on May 12th, 1856, the line from Cowley Bridge, Exeter, to Crediton, which was extended to Fremington Pill, Barnstaple, on July 12th, 1854, and to Bideford on November 2nd, 1855.

In the direction of Exeter the line was opened from Basingstoke to Andover on July 1st, 1854; to Salisbury, May 1st, 1857; to Gillingham, May 1st, 1859; to Sherborne on May 7th, 1860; to Yeovil, June 1st, 1860; and to Exeter, Northernhay—now Queen-street—on July 19th, 1860. The branch to Exmouth was brought into use on May 1st, 1861. Immediately on the west side of Exeter was the just mentioned Crediton–Barnstaple line, and in 1860 powers were obtained to extend the line from Northernhay to the St. David's Station, and to arrange with the Bristol and Exeter and the South Devon to lay a third rail to Cowley Junction. On August 1st, 1862, the Barnstaple line was extended to Bideford, and in March, 1863, through communication by standard gauge trains from Waterloo to that town was effected. Trains for Plymouth leave the Barnstaple line at Yeoford Junction, and the section from the latter place to North Tawton was opened on November 1st, 1865; thence to Sampford Courtenay on January 8th, 1867; to Okehampton on October 3rd, 1871; and to a junction with the Great Western at Lydford on October 12th, 1874. The branch off this line at Maldon Junction to Launceston was opened on August 29th, 1871; the Bideford line was extended to Torrington on July 18th, 1872; and the Ilfracombe branch from Barnstaple was opened on July 20th, 1874.

What became the Somerset and Dorset Joint (London and South-Western and Midland) Railway began at Highbridge and was brought into use as follows:—To Glastonbury on August 28th, 1854; branch to Wells, March 15th, 1859; Blandford to Wimborne, on the Southampton–Dorchester, November 1st, 1860; Templecombe–Cole, November, 1861; Glastonbury–Cole, February 1st, 1862; Templecombe–Blandford, August 21st, 1863.

The line from Staines to Wokingham and thence over the South-Eastern to Reading was opened to Ascot on June 4th, 1856, and throughout on the 9th of the succeeding month. The Lymington branch was completed on July 1st, 1857; the Portsmouth line from Godalming on January 1st, 1859; the Wimbledon–Epsom, April 4th, 1859; Ringwood–Christchurch, November 13th, 1862; the Stokes Bay, Chard, Bishop's Waltham and Twickenham–Kingston branches on April 6th, May 8th, June 6th, and July 1st respectively in 1863. The branch from Petersfield to Midhurst was brought into use on September 1st, 1864; that to Shepperton on November 1st, 1864; the line from Andover to Redbridge on March 6th, 1865; the Alton line was continued to Winchester on October 2nd, 1865; the Portwood–Netley line was opened on March 5th, 1866; and the Weybridge–Chertsey extended to Virginia Water on October 1st, 1866.

It will be convenient here to mention the Isle of Wight railways. Their dates were: Ryde–Shanklin, August 23rd, 1864; Shanklin–Ventnor, September 10th, 1866; Sandown–Newport, February 1st, 1875; Newport–Ryde, December 20th, 1875.

The line from Salisbury to Wimborne was brought into use on December 20th, 1866; the Ringwood–Christchurch was extended to Bournemouth on March 14th, 1870; and, in the opposite direction, the Poole branch of the Southampton–Dorchester of 1847 was carried forward to Bournemouth on June 15th, 1874. On July 20th of the latter year the Somerset and Dorset was made complete by its extension northwards from Evercreech to Bath.

The remainder of the openings were of branches as follows:—Seaton, March 16th, 1867; Malden–Kingston and Shepherds Bush–Richmond, January 1st, 1869; Brookwood–Aldershot, May 2nd, 1870; Calstock–Callington, May 7th, 1872; Hamworthy, December 2nd, 1872; Sidmouth, July 6th, 1874.

London and Brighton.

The origin of the London, Brighton and South Coast Railway was the London and Croydon Railway—5 Will. IV., c. 10, 1835—which connected Croydon with the London and Greenwich Railway—see the South-Eastern below. It ran on the bed of the Croydon Canal. It was opened on June 5th, 1838, as between West Croydon and Corbet's-lane Junction, and from the latter point the Croydon Company had running powers over the London and Greenwich to London Bridge Station. It had been intended to use the Greenwich Station there, but under powers obtained in the following session, the Croydon Railway built its own station. The London and Brighton and the South-Eastern proposed to use the same rails into London, but the Select Committee of 1839 was very concerned as to the danger of so doing, and further powers were given. They did not prove wholly satisfactory and, as a consequence, the Bricklayer's Arms branch and station were built by the South-Eastern. The Croydon Railway was worked on the atmospheric system until the London and Brighton acquired it in 1846.

The London and Brighton Railway was incorporated by 1 Vic., c. 119, 1837, to make a line from the London and Croydon, south of Norwood Junction, to Brighton, with a branch to Shoreham. No fewer than five schemes, some designed by Stephenson and Rennie, were before Parliament in 1836. All were rejected, and Captain Alderson, with the concurrence of the several promoters, was appointed by the Government to recommend a route. As a result of his report the five sets of promoters combined their forces in 1837 in support of a Bill based on Rennie's scheme which was passed. The Act authorised the purchase of the Croydon, Merstham and Godstone Railway of 1803—see Article No. IV.—and some of that line was used.

The engineer was John U. Rastrick, and the line was opened from Brighton to Shoreham on May 6th, 1840, from the Croydon to Hayward's Heath on July 12th, 1841, and Hayward's Heath to Brighton on September 21st, 1841. It was inspected by Sir Frederick Smith, who reported that "at almost all the stations on this line the engineer had laid down four sets of rails . . . so that the engines and carriages will not stop upon the main lines . . . an arrangement which, by tending much to the safety of the travellers, is highly creditable to the company." The Merstham Tunnel is 1780 yards in length, Balcombe 1122 yards, and Clayton 1 mile 20 chains. The Ouse Viaduct is 480 yards long and of 37 semi-circular arches, each of 30ft. span, and has an extreme height of 96ft.

The Shoreham line was extended to Worthing on November 24th, 1845; to Ford March 16th, 1846; to Chichester, June 8th, 1846; to Havant, March 15th, 1847; and to Portsmouth on June 14th, 1847. In the opposite direction Lewes was reached from Brighton on June 8th, 1846; Hastings on the 27th *idem*; Lewes was given direct access from London by the Keymer branch on October 2nd, 1847; and the Newhaven branch was opened on December 8th following. Communication with Eastbourne was made on March 14th, 1849; and with Hailsham on May 14th of the same year.

On May 10th, 1847, the Croydon line was extended to Epsom, and on March 4th of the following year a branch from Three Bridges to Horsham was opened. A branch from Sydenham to the Crystal Palace was brought into use on June 10th, 1854, and was extended to Wandsworth—Clapham Junction—with a connection from Norwood Junction, and was carried on to Battersea on March 29th, 1858, and to Victoria Station on October 1st, 1860, the last by running over the London, Chatham and Dover metals. The branch from Three Bridges to East Grinstead was brought into use on July 9th, 1855; Croydon–Wimbledon, which used some of the Surrey Iron Railway, described in Article No. IV., on October 22nd, 1855; Lewes–Uckfield, October 11th, 1858; Epsom–Leatherhead, February 1st, 1859; and an extension of the Three Bridges–Horsham to Pulborough and Petworth on October 10th of the latter year. The line from Shoreham to Itchingfield Junction, Horsham, was opened to Partridge Green on July 1st, 1861, and the remainder on the following October 1st.

A direct route to Victoria was given by the Croydon–Balham line on December 1st, 1862; the Pulborough line was extended to the Brighton–Chichester on August 7th, 1863; the Newhaven branch was carried to Seaford and the Bognor branch opened on June 1st, 1864; and the Epsom Downs branch on May 22nd, 1865. The South London was opened as far as Peckham on August 1st, 1865; to Denmark Hill on August 13th, 1866; and throughout May 1st, 1867. The Guildford–Horsham was opened October 2nd, 1865; the East Grinstead–Tunbridge Wells, October 1st, 1866; the Petworth–Midhurst, October 15th, 1866; and continued to Chichester on December 15th following; the Leatherhead–Horsham, to Dorking, on March 11th, and throughout on May 1st, 1867; the Hayling Island branch, July 16th, 1867; and the Lewes–Uckfield was extended to Groombridge on August 3rd, 1868. The direct line from Peckham Rye to Sutton was opened on October 1st, 1868, and on the same day the branch from Streatham Junction to the Wimbledon and Croydon.

South-Eastern.

The South-Eastern Railway possessed the first post-Stockton and Darlington Railway built in the South of England. This was the Canterbury and Whitstable—7 & 8 Geo. IV., c. 11, 1825—which was opened on May 3rd, 1830, as from Whitstable Harbour to Slade-lane, Canterbury. The Act provided that it was to be worked by locomotives, fixed engines and horses. There were three winding engines and some of the gradients were 1 in 28, 1 in 31 and 1 in 46. There was one tunnel—Tyler Hill—828 yards long. The locomotive used was the well-known Invicta, built by Stephenson immediately after the Rocket—the Rocket was No. 11 in Stephenson's books and the Invicta was No. 12. Like the Glenfield Tunnel on the West Bridge branch of the Midland Railway—see Article XVII.—the Tyler Hill Tunnel causes loads on the Canterbury and Whitstable line to be limited, to this day, to a height in the centre of 11ft. 4in. and a width of 8ft. 9in. When the Ashford, Canterbury and Margate branch of the South-Eastern was built under 7 & 8 Vic., c. 25, 1844, it crossed the Whitstable line on the level and this crossing still exists. Under the same Act the Canterbury and Whitstable was leased to the South-Eastern, and it was then modernised and worked throughout by locomotives. A physical connection between the Ashford and Whitstable lines was also put in.

The next oldest section of the South-Eastern is the London and Greenwich Railway—3 Will. IV., c. 46, 1833—which was the first railway in the Metropolis. It began in Duke-street near London Bridge, and ended in London-street, Greenwich, and had an intermediate station at Spa-road. The line was on arches throughout with the idea that road traffic would not be interfered with, and that the arches would bring in a revenue from rents as warehouses, shops and dwelling places. There were 880 arches. The line was opened from London to Deptford on December 14th, 1836, but some portion was opened earlier than that date, as the line was in use on the Easter Monday of 1836. The portion from Deptford to Greenwich was brought into use on December 24th, 1838.

The South-Eastern itself was incorporated by 6 & 7 Will. IV., c. 75, 1836. It had powers to make a railway from the London and Croydon Railway to Dover. The line did not, however, materialise as such. Its promoters were anxious to serve Brighton as well as Dover and, by agreement with the London and Brighton, a clause was inserted in the latter company's Act allowing the South-Eastern, any time before December 1st, 1840, to purchase the Brighton line from London up to the point where the Dover line diverged towards Kent. By 2 & 3 Vic., c. 79, 1839, this arrangement was changed; the South-Eastern proper was to start at Reigate–Redhill—and northwards of that point the Brighton line was to be jointly owned by both companies; from Norwood to Coulsdon was vested in the Brighton Company, and Coulsdon to Redhill in the South-Eastern. The latter company paid £340,000 for this privilege, and its trains ran free of toll. The Brighton was also to run toll free between Croydon and Redhill and over the Greenwich line and the Bricklayer's Arms branch. There was also to be a joint station at London Bridge. Cubitt was the engineer.

From Redhill to Ashford, a distance of 45 miles, the route of the line was remarkable. It was over a course nearly due east, almost in a mathematical straight line and a dead level. This, moreover, was not obtained by expensive cuttings or embankments, and the whole presented a more remarkable engineering feat than Brunel's Great Western line. Furthermore, there was nothing between London and Bristol to equal the work of carrying the South-Eastern line under the cliffs between Folkestone and Dover. Cubitt's work there, in bringing down the mass of chalk by gunpowder charges, fired by electricity, created great interest in engineering and scientific circles when it was done in April, 1843.

The Dover line was opened thus:—Redhill–Tonbridge on May 26th, 1842; Tonbridge–Headcorn, August 31st, 1842; Headcorn–Ashford, December 1st, 1842; Ashford–Folkestone, June 28th, 1843; and Folkestone–Dover, February 7th, 1844. The Bricklayer's Arms branch was brought into use on May 1st, 1844. Subsequent extensions of the Dover line were:—Tonbridge–Tunbridge Wells, September 20th, 1845; Ashford–Margate, December 1st, 1846; Minster–Deal, July 1st, 1847; Ashford–Hastings, February, 1851.

The Greenwich line was to be extended to Rochester and the portion between Gravesend and Rochester was opened on August 23rd, 1847, and that between Greenwich and Gravesend on July 29th, 1849. It was further extended to Maidstone on June 18th, 1856. The two extreme points of the Reading, Guildford and Reigate, *i.e.*, from Reading to Farnborough and from Reigate–Redhill to Dorking, were opened on July 4th, 1849, and the intervening portion, including the part between Ash and Shalford Junction, Guildford, which was over the London and South-Western, on August 20th following. The line from Tunbridge Wells to St. Leonards was brought into use in three stages:—To Robertsbridge in November, 1851; to Battle on January 1st, 1852; and to St. Leonards on February 1st, 1852. The Caterham branch was opened on August 5th, 1856; the Lewisham–Beckenham on January 1st, 1857; and the Beckenham–Addiscombe-road on April 4th, 1864.

Not until 1864 were any further extensions brought into use. In August of that year the line from London Bridge to Charing Cross was opened, and that to Cannon-street on September 1st, 1866. The Lewisham–Tonbridge line was put into traffic in three stages:—To Chislehurst on July 1st, 1865; to Sevenoaks on March 2nd, 1868; and to Tonbridge on May 1st of the latter year. The New Cross–Dartford was opened on September 1st, 1866; and the Sandling Junction–Sandgate, on October 10th, 1874.

London, Chatham and Dover.

The origin of the London, Chatham and Dover

was the East Kent Railway, of 16 & 17 Vic., c. 132, 1853. It ran from Rochester to Canterbury, and, later, thence to Dover. The openings were as follows:—Rochester–Faversham, October 25th, 1858; Sheerness branch from Sittingbourne, October, 1858; Faversham–Canterbury, July 8th, 1860; branch to Herne Bay from Faversham opened to Whitstable, August 1st, 1860, and on to Herne Bay, July 13th, 1861; Canterbury–Dover Town, July 22nd, 1861; Dover Town–Dover Harbour, November 1st, 1861. The St. Mary Cray line was opened from Bromley on May 3rd, 1858, and was connected to the London, Chatham and Dover at Rochester on December 3rd, 1860. A connection to Sevenoaks off the St. Mary Cray–Rochester line at Swanley was brought into use on June 2nd, 1862.

In the Metropolitan area the line from Victoria to Herne Hill was opened on August 25th, 1862; from Herne Hill to Elephant and Castle, October 3rd, 1862, on to Blackfriars, June 1st, 1864, and to Holborn Viaduct, March 2nd, 1874. From Nunhead to the Crystal Palace was brought into use on August 1st 1865; Herne Hill–Tulse Hill, January 1st, 1860; and Nunhead–Blackheath Hill, September 18th, 1871. From Otford Junction–Maidstone to Sevenoaks was opened on June 1st, 1874.

British Wire-drawing and Wire-working Machinery.

No. XVI.—NAIL AND RIVET MAKING MACHINES.*

WHAT is known as the Birmingham type of nail-making machine is probably the most extensively used form in this country, although there is a tendency towards the adoption of the American type. This series of articles is not, however, intended to embrace foreign machinery, and it will be sufficient to say of the American nail-making machine that it employs steady pressure instead of a blow for forming the head.

Wire nail machines are made principally in the Birmingham district by a number of firms, but they are all so very much alike that it is unnecessary to deal with more than one, and that taken for illustrative purposes in this article is by Wm. Grice and Sons, Limited, of Fazeley-street, Birmingham.

The general appearance of the machine can be gathered from Fig. 120, while Fig. 121 is a general arrangement. It will be noticed that these machines are very substantially built, which is necessary to withstand the hard service they are commonly subjected to, but otherwise they possess no remarkable constructional peculiarities, so we will proceed directly to the method of operation.

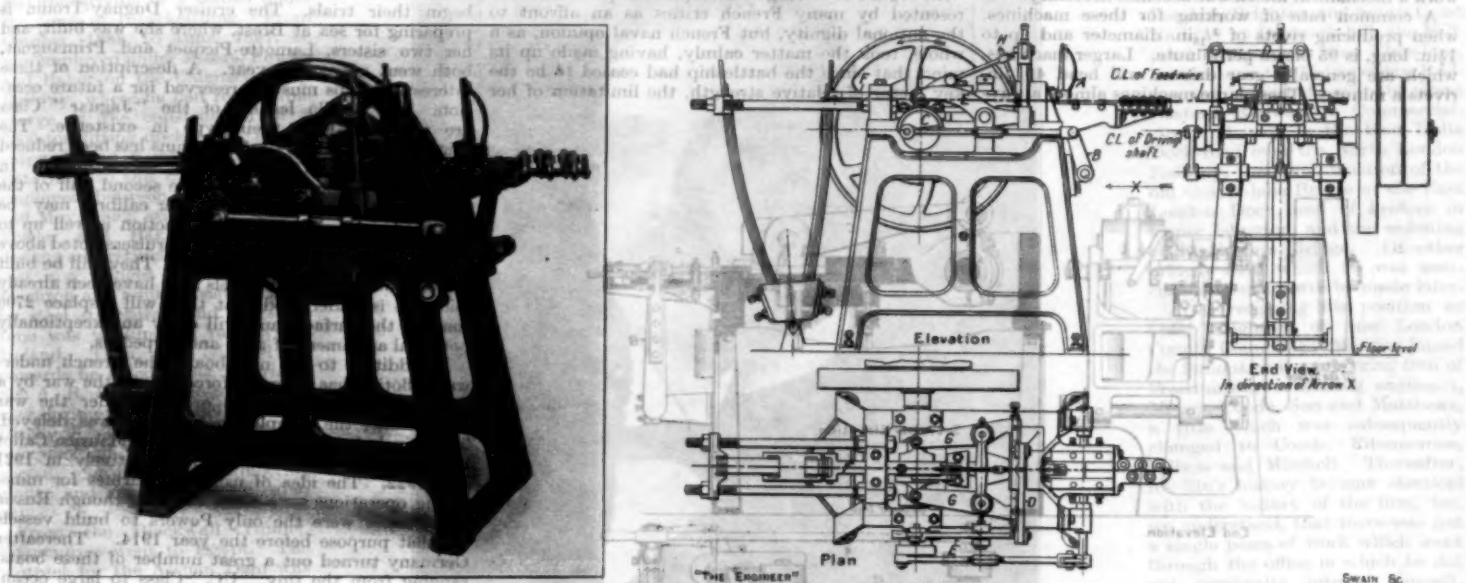
The wire is drawn into the machine through a set of straightening rolls, and is fed forward by a grip A—see Fig. 121—which is reciprocated by the rocking lever B and crank C. The throw of the crank can obviously be set according to the length of nail to be made. The grip is a simple trigger, kept in contact with the wire by a light spring, and holds the wire tightly on the forward stroke. When moving backwards, however, it slides over the wire, which is then held by the gripping dies, and consequently cannot return even if the feed grip is somewhat stiff.

The gripping dies have to hold the stock very firmly, and are aided in this by projections which form the familiar serrations in the nail shank, just below the head. The grip is made in a vertical direction, with the lower die stationary. The upper die is pulled down by a powerful set of levers D and E, actuated by a cam just inside the feed crank disc, and is raised on the return, or opening, stroke by a helical spring. While the wire is held by these dies, the head is formed by a single blow of the heading die, which is propelled forward by the laminated bow spring seen at the rear of the machine.

The heading die is fixed in the end of the ram F, which slides in guides over the top of the main shaft. On the shaft there is a single beaked cam, which engages a projection on the ram, forcing it back and compressing the spring. As soon as the cam overrides the projection, the ram is free, and is shot forward violently with such force that a single blow of the die is sufficient to form the nail head. The noise made, not only by the actual blow, but also by the spring as it is suddenly compressed, is so great that it is quite futile to attempt conversation in a shop where there is a battery of nail-making machines at work.

After the head has been formed, the gripping dies open and the wire is pushed forward by the next feed movement. It then becomes necessary to form the point of the nail, and cut it off from the stock. The two operations are performed simultaneously by a pair of dies moving in a horizontal direction. These dies are worked by the two levers G G, and corresponding cams on the main shaft. The dies produce a squeezing, rather than a cutting, action, and are formed by making three nicks in the end of a piece of tool steel with a "three-square" file. The faces of a pair of dies are well shown in the cut, Fig. 122, but it should be pointed out that, for illustrative purposes, the two dies are shown approaching one another at an angle, whereas they are in line when at work.

The dies squeeze out the metal in two triangular fins, or "nibs," as they are called in the trade, with deep nicks on all sides, which nearly sever the metal.



FIGS. 120 AND 121—WIRE NAIL-MAKING MACHINE—W. GRICE

The dies cannot, of course be made to cut right through the wire, as they would then come in contact with one another and be destroyed; but by careful adjustment the nicks are made so deep that the nail is ready to fall off the stock after it has been pointed. In order to make sure, however, that the nail will fall clear before the next stroke of the heading die

FIG. 122—NAIL-POINTING DIES

a striker H comes down from above and knocks it into a receptacle below.

An important point in connection with the cutting of the dies is that they should be so formed that the completed nail will carry away the nibs with it, and not leave them on the stock, as the stock must be left with a clean square end or the next head will be deformed. It is also essential that the point should be symmetrical or it will not go straight when it is driven by a hammer.

The nails are subsequently put in tumbling barrels to knock off the nibs, and to give them a good polish. The nibs, by the way, have a high market value in the steel trade as scrap, on account of the dense manner in which they pack together.

Machines of the type just described run at a really remarkable speed, considering the extent of the deformation of metal which the production of each nail involves, and produce anything from 90 up to 300 pieces per minute. That is to say, nails from 5in. to 6in. long can be made from No. 4 gauge wire at a rate of from 90 to 100 per minute, while the output of small nails of, say, 1in. length, by No. 14 gauge, is at least 300 per minute. The power required even by the largest machine is only some 2 horse-power.

In some factories, such as Rylands, at Warrington, the better-class nails are all sorted over by hand to eliminate any that may be defective, and this sorting is carried out by boys as the nails slide down a flat steel plate vibrated by a power-driven hammer.

The twisted or screw nails, which are sometimes used for such purposes as fastening packing cases, are made in the manner just described, but the wire is given its spiral groove before being sent to the nail-making machine. Ordinary round wire is drawn through a rotating spindle, and either one or the other of two systems is employed to make the spiral groove. In one there are three or four balls—the same as are used in ball bearings—mounted in the spindle, and they deform the wire, as it is forcibly drawn through, into a spiral with a pitch depending on the relation between the speed of draw and the speed of rotation of the spindle. In the other system a more or less sharp groove is cut in the wire by a set of disc cutters, mounted at an angle with the axis of rotation of the spindle. If proper precautions are taken to eliminate undue friction in the revolving parts, the angularity of the cutters will produce the necessary rotation of the spindle without it being necessary to provide it with an individual drive.

In making rivets from wire stock, a different process is adopted, as compared with the formation of pointed nails, and Fig. 123 illustrates the essential features of the machine employed.

The primary peculiarities of the machine lie in the facts that each length of wire is cut off from the stock before it is headed, while the head is formed by steady pressure instead of by a sudden blow.

On reference to the drawing, Fig. 123, it will be seen that the line of the feed does not coincide with the axis of the heading tools. (It is, by the way, hardly necessary to enlarge upon the mechanism of the feed gear, except to point out that by lifting the notched lever A off its pin on the rocking lever B, the feed is stopped.) The reason for this lack of alignment is the fact that the rivet must be left with a perfectly smooth shank, and consequently cannot be gripped, sideways, sufficiently firmly to withstand the heading pressure. In other words, the end of each blank must bear against a solid abutment during the heading operation.

The wire consequently is fed forward through a tunnel to the extent necessary to produce a rivet, and is projected between two dies held slightly apart. The dies are then closed together, and moved across the mouth of the tunnel, against the pressure of a spring, so that the wire is sheared off against the edge of the tunnel mouth and is carried bodily sideways until it is in line with the heading tools. In this position the butt end of the blank bears against the plain face of the tunnel die, and is consequently well supported against the heading pressure.

The gripping and transverse movement of the dies is generally effected by a wedge-shaped piece, which is pressed forward by a lever, such as C, operated by a cam on the main driving shaft. The heading die D is mounted in a ram which is worked by an excentric on the main shaft.

When the rivet has been headed, the gripping dies move back to the original position, then open and the oncoming stock pushes the rivet out, to fall down into a container below. It will be appreciated that when the rivet is ejected from the gripping dies, it is out of line with the heading tools, and consequently has more opportunity to fall clear before the next stroke of the ram takes place than is the case with a nail-

* No. XV. appeared November 7th.

THE FRENCH MINE-LAYING SUBMARINE PIERRE CHAILLEY

AUGUSTIN NORMAND ET CIE., HAVRE, BUILDERS AND ENGINEERS

making machine, where all the operations are performed in one line. As a consequence, it is not always necessary to have a knock-out to throw the completed rivets out of the machine, but with really high-speed work a mechanical knock-out becomes necessary.

A common rate of working for these machines, when producing rivets of $^{7}/_{16}$in. diameter and up to 1½in. long, is 95 pieces per minute. Larger machines, which are generally gear driven, will head 40 ¼in. rivets a minute. These large machines almost always have cast steel frames, to withstand the heavy stresses involved in the heading operation, and some idea of their substantialness may be gathered from the fact that their weight may be as much as 8 or 9 tons.

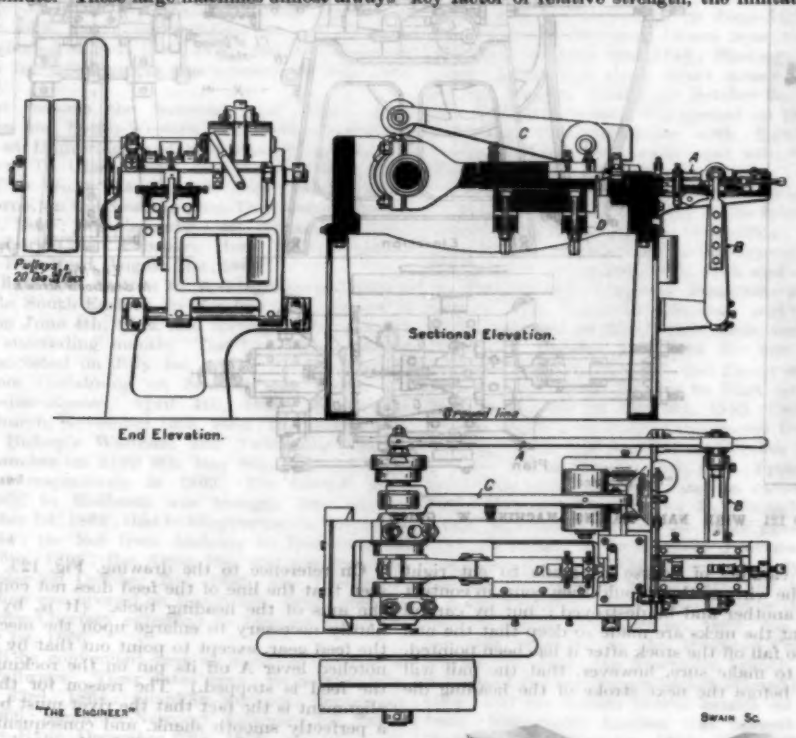


FIG. 123—RIVET-MAKING MACHINE

French Naval Construction.

Compelled by military exigencies to suspend all major naval construction during the war, France found herself at the end of the struggle with a more or less obsolete fleet. She had no capital ships embodying the latest tactical principles, no light cruisers of modern design, no aircraft carriers, and few destroyers or submarines that were really up to date. Although the French naval forces had performed a great deal of valuable work in the Mediterranean and Northern waters, their war record was overshadowed by the achievements of the army, which had been more in the public eye. When, therefore, the time came to provide for the peace requirements of the two services, the claims of the navy received scant attention, and it was not until March, 1922, that a systematic programme of new construction was adopted. In the interval France had been reminded of the importance of sea power by the proceedings at the Naval Conference in Washington, where in spite of her more extensive maritime interests she was placed on the same level as Italy with regard to strength in capital ships. This was resented by many French critics as an affront to the national dignity, but French naval opinion, as a whole, took the matter calmly, having made up its mind that since the battleship had ceased to be the key factor of relative strength, the limitation of her battle fleet need not prevent France from maintaining a dominant position in the Mediterranean. To achieve this object it was deemed essential to create a powerful force of light high-speed surface vessels, a new submarine flotilla, and a large establishment of aircraft. Hence the programme of 1922, of which the first part is now approaching completion.

The two sections of the programme provide respectively for the following vessels :—

First Section.

3 cruisers of 8000 tons,
6 flotilla leaders of 2400 tons,
12 destroyers of 1400 tons,
12 submarines of 600 to 1148 tons, and
1 aircraft carrier (formerly the battleship Béarn).

All the above ships are due for completion before the end of 1925.

Second Section.

6 cruisers of 10,000 tons,
15 flotilla leaders of 2400 tons,
24 destroyers of 1400 tons,
2 submersible cruisers of about 3000 tons,
30 submarines of 1385 tons,
7 submarine minelayers of 600 to 1300 tons,
2 surface minelayers, and
4 oil tankers.

All the vessels in the second section are due for completion by 1931 at latest.

No delay is anticipated in the execution of the first section of the programme. The majority of the vessels have been launched, and some will shortly begin their trials. The cruiser Duguay-Trouin is preparing for sea at Brest, where she was built, and her two sisters, Lamotte-Picquet and Primauguet, both went afloat this year. A description of these interesting ships must be reserved for a future occasion. The flotilla leaders of the "Jaguar" Class are the largest of their type in existence. The original armament of six 5.1in. guns has been reduced to five in order to improve their seaworthiness. In the leaders to be built under the second half of the programme guns of still larger calibre may be mounted. All submarine construction is well up to time-table. The two submersible cruisers noted above are the Vengeur and Redoutable. They will be built at Cherbourg, where the keels may have been already laid. It is understood that they will displace 2700 tons on the surface, and will carry an exceptionally powerful armament of guns and torpedoes.

In addition to the new boats, the French underwater flotilla has been reinforced since the war by a few submarines that were ordered under the war programme, the completion of which was delayed. These include the minelaying boats Maurice Callot and Pierre Chailley, launched respectively in 1921 and 1922. The idea of using submarines for minelaying operations ante-dates the war, though Russia and France were the only Powers to build vessels for that purpose before the year 1914. Thereafter Germany turned out a great number of these boats, ranging from the tiny "UC" Class to large ocean-going craft with a displacement of nearly 2000 tons. It is possible that certain features of the German design have been incorporated in French submarine minelayers completed since the war, though this is pure surmise. By the courtesy of Messrs. Augustin Normand et Cie., of Havre, who built the boat, we are able to reproduce a view of the Pierre Chailley, which was launched in December, 1922, and carried out trials this year. The leading particulars of the boat are as follows:—Length, 229ft. 8in.; breadth, 26ft. 3in.; draught, 13ft.; displacement on surface, 827 tons; submerged, 1122 tons. Surface propulsion is effected by two Diesel engines developing together 1800 brake horse-power, equivalent to a speed of 14 knots. Electro-motors of 1200 horse-power drive the boat at 9 knots in submerged condition. Sufficient fuel is carried for a surface cruise of 2800 miles, while the submerged cruising endurance is limited to 80 miles. A 3.9in. gun, firing 30 lb. shell, is mounted on deck, and three 18in. torpedo tubes are fitted in the bows. The mines, of which 24 are carried, are understood to be ejected through inclined chutes.

According to the *Electrical Times*, a new type of "one man" tramcar is, it is stated, to be put into service on the London United Tramway Company's Hanwell and Brentford route. It is the first of a batch of five single-deckers now being constructed by the company. The doors are operated pneumatically, and are automatically kept closed while the car is in motion by means of a special valve. When the car is at a standstill, the exit door will not open unless a passenger is waiting on the rear platform ready to alight, the door being controlled by valves through a tread-plate. A "safety first" device is the "dead man grip" with which the air brake handle is fitted. If the driver takes his hand off this, the brakes are automatically applied and current cut off. The new car seats thirty passengers, and fares are paid as they enter. The coin is dropped into a fare box, and the driver issues the ticket, which is cancelled by a foot-operated punch. A change-giving machine assists the issue of tickets.

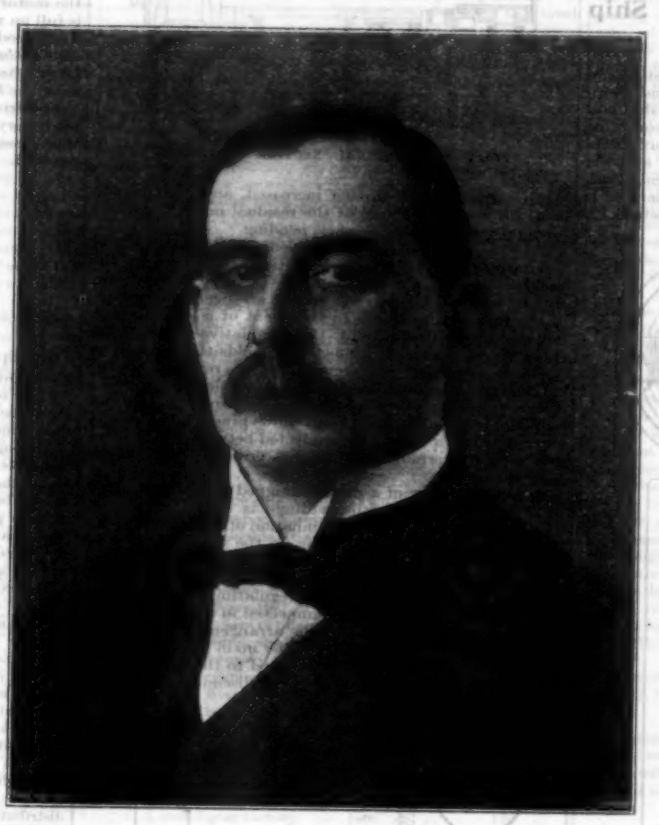
Obituary.

SIR MAURICE FITZMAURICE.

It is with deep regret, which will be shared by the whole of the engineering profession, that we have to record the death of Sir Maurice Fitzmaurice, which took place in London on Monday last. Sir Maurice had been unwell for some time, but his illness only took a really serious turn a fortnight or so ago.

Maurice Fitzmaurice, who was the son of Dr. Robert Fitzmaurice, of Cloghers, Tralee, was born on May 11th, 1861. He was therefore only in his sixty-fourth year at the time of his death. After receiving his scholastic training, he followed for the three years 1880–83 the course in engineering at Dublin University under Professor R. Crawford, M. Inst. C.E., and obtained degrees of Bachelor of Arts and Bachelor of Engineering, with a special certificate of proficiency in the latter. From Dublin he came straight to London to be articled to the late Sir (at that time Mr.) Benjamin Baker. At the expiration of his articles he was engaged from January, 1885, to October, 1888, under Mr. Baker and Sir John Fowler on the Forth Bridge, where the construction of the south main pier—comprising the sinking of four caissons by air pressure and the erection of some 18,000 tons of steel work—was under his supervision. During the last two of the years mentioned, he was also in responsible charge of the building of the approach railways on both sides of the Forth, which involved heavy cuttings, the construction of a viaduct with four 100ft. spans, and the driving of a tunnel under the town of Inverkeithing. From October, 1888, to June, 1891, he was employed under Messrs. Fowler and Baker on the Chignecto Ship Railway, where he had responsible charge of the construction of a 3000-ton lifting dock basin, a gate entrance and 8 miles of railway. Returning to this country, he was employed between August, 1891, and May, 1892, still under Messrs. Fowler and Baker, in making designs and estimates for replacing cast iron bridges on the London, Brighton and South Coast Railway by steel structures, and for some time was working on railways in Ireland. Then, from May, 1892, onwards he acted under Mr. (later Sir) A. R. Binnie as resident engineer during the construction of the Blackwall Tunnel. During the course of all these works he displayed conspicuous engineering ability and great organising capacity.

From the Blackwall Tunnel, Fitzmaurice went to Egypt. The contract for the Assuan Dam was signed on February 21st, 1898, the contractors being John Aird and Co., Limited, who undertook to carry out the work for the sum of £1,500,000. At that time Mr. (afterwards Sir) W. Willcocks, who had designed the dam, had been succeeded as Director-General of Reservoirs by Mr. W. J. Wilson. Sir Benjamin Baker was appointed consulting engineer, and it was doubtless on his recommendation that Fitzmaurice was appointed resident engineer in charge of the construction. Early in the May of 1898 the latter, in company with Mr. John A. C. Blue, Messrs. Aird's agent, had arrived at the site to make all the preliminary arrangements necessary for the large staff and the great number of workmen who would be employed. His first impressions, set out in a paper which he read before the Institution of Civil Engineers when the work was completed, are worth quoting. He said:—"It would be hard to imagine a more desolate and uninviting spot than the site of the dam at that time; and the tourist who now visits Assuan during a few months in the winter would hardly recognise it in the middle of an Egyptian summer, and without a single European living in the place. With the exception of a few native villages, no sign of life was anywhere visible. The five main channels of the river flowing between the barren and baked granite rocks, and then forming a torrential cataract as they fell over the granite crest into the lower reach of the river, gave the impression that the contract time of five years was none too long for such an undertaking. The granite hills bordering the river rising to several hundred feet above water level, were covered on one side of the river by the bright yellow sand of the Sahara Desert, and on the other by the dark granite sand of the Eastern Desert, which extends from the Nile to the Red Sea." It was in such surroundings that what eventually approximated to a fair-sized town was constructed, its water supply safeguarded and its sanitary arrangements provided for. That all was well done is testified to by the fact that although, at times, the population around the dam, either directly employed, or connected with it, did not fall far short of 15,000 persons, there was never any serious epidemic, and only a few occasional cases of typhoid and small-pox. The difficulties under which the preliminary work was carried on may, to some extent, be appreciated when it is remembered that at the time only a single line of 4ft. 8½in. gauge railway ran as far south as Luxor, and that though between Luxor and Assuan there had just been constructed a 3ft. 6in. gauge line, it was almost entirely in the hands of the military authorities since the Sudan Expedition of 1898 was still in progress, and practically no ordinary goods were accepted by the railway. Beyond Luxor, therefore, it was necessary to convey by water a large amount of the supplies for the dam. All food had to be obtained from Cairo or Alexandria, and it took anything from a week to a fortnight on the way. On several occasions during that first six months the stocks of food, to use Sir Maurice's own words, "became rather limited." Even later, when military operations were no longer being carried on, it was by no means easy to make the necessary arrangements, yet they were made, and in the making of them Sir Maurice had his full share, and, although on one or two occasions the stock, both of cement and of coal, ran low, there was never actually any time lost on that account. To quote Sir Maurice once more: "All cement and coal came from England to Alexandria; 75,000 tons of the former and 28,000 tons of the latter were used during the construction of the dam. This amount of material, in addition to all other supplies for the dam, thrown at irregular intervals on a single line of railway, which at normal times has about as much traffic as its rolling stock can deal with, entailed very considerable extra work and organisation on the part of the railway authorities."



SIR MAURICE FITZMAURICE

In spite of Sir Maurice's misgivings referred to above as to the contract time of five years being insufficient for the completion of the dam, the structure was actually finished in 1902, or within the contract time. It was a magnificent piece of work, most admirably carried out, and Sir Maurice might well have been proud of his share in it.

Shortly after his return to this country, Sir Alexander Binnie, under whom, it will be remembered, Fitzmaurice had worked on the Blackwall Tunnel, resigned his position as Chief Engineer to the London County Council, and his former assistant was chosen to fill his place. Of the work which he did in the course of the eleven years during which he held that office, a very great deal might be written. It is a most onerous and responsible post, and very ably Sir Maurice occupied it. In fact, to so great an extent did he exhaust his energies in the service of the Council that for a time he suffered in health. To mention a few of the works which were designed by him and carried out, either entirely by him or completed in part before he retired in 1912, we may cite the duplication of the main drainage of London; the London County Council tramways; the Rotherhithe Tunnel; the underground tramway from the Embankment up Kingsway to the north; the Greenwich and Woolwich footways under the river; the Woolwich Ferry jetties; the coal wharf for the London County Council tramway power station at Greenwich; the new Vauxhall Bridge; the prolongation of the Thames Embankment on the north bank upstream of the Houses of Parliament, and the embankment for the new County Hall on the south bank of the river. Incidentally, we may say that it was at the laying of the foundation stone of the new Hall that Sir Maurice received his well deserved knighthood.

During his career, whether with Messrs. Fowler and Baker, with the London County Council or subsequently, Sir Maurice was concerned in one way or another with a remarkable number of bridges. There were, first of all, the Forth and new Vauxhall bridges already alluded to. Then he formed a member of the Commission set up to inquire into the collapse of the Quebec Bridge. Beyond these, there were the reconstruction of Putney Bridge and of Deptford Creek Bascule Bridge and either alterations or reconstruction of Hammersmith Bridge, the Albert Bridge, new Battersea Bridge, the Isle of Dogs Swing Bridge, Rosemary Branch Bridge over the Regent's Canal, High-street, Kingsland, bridge over the North London Railway, the bridges under the dock entrance in Grosvenor-road, a bridge over the London, Brighton and South Coast Railway at Denmark-hill, the Mill-pond Bridge over Nine Elms-lane, bridges over the Metropolitan Railway in Clerkenwell, over the Great Eastern Railway in Commercial-street, E., and in the East India Dock-road over the North London Railway, the reconstruction of the old Gravel-lane Bridge at the East London Dock, and of bridges in Upper Islington, and the widening of Blackfriars Bridge. Of other bridges with which he was associated, mention will be made later.

After resigning his position as Chief Engineer of the London County Council, Sir Maurice joined the famous civil engineering firm of Westminster consulting engineers, Messrs. Coode, Son and Matthews, a title which was subsequently changed to Coode, Fitzmaurice, Wilson and Mitchell. Thereafter, his life's history became identical with the history of the firm, for, we understand, that there was not a single piece of work which went through the office in which he did not personally interest himself. It would be impossible in a memoir of this kind to indicate all the subjects covered during his twelve years' partnership in the firm, and the enumeration of but a few must suffice:—Harbour works at Dover, Peterhead, Colombo, Singapore, Killindini, and Lagos; a proposed wharfage scheme at Hong Kong; the Johore Causeway between the island of Singapore and the mainland; the wharves at Prai in the Malay Peninsula; and the proposed tunnel at Dartford. Sir Maurice, in conjunction with Mr. Basil Mott, was called in to advise on the question of a further tunnel under the Mersey. With Mr. Mott, too, he was engaged on the design of the new bridge to be constructed at Newcastle-on-Tyne, which has now reached such a stage that contracts for the work are being invited. Then, again with Mr. Mott, he was called in by the London County Council to advise what was best to be done with Waterloo Bridge when it gave signs of failure. An undertaking to which he had devoted much study recently was the Gezira irrigation scheme which includes the building of the Sennar Dam on the Blue Nile, and in connection with which his firm is acting in a consulting capacity.

In 1913 Sir Maurice was invited by the Commonwealth Government to visit Australia with a view to giving his advice concerning the construction of naval harbours and works—a work for which he was particularly suited, since he occupied the position of Chairman of the Admiralty Advisory Committee on Naval Works. During the war he was, amongst other things, Chairman of the War Office Committee on Civilian Labour on the London Defences, and a member of the War Office Committee on Hutted Camps. He twice visited the British front on the Continent on questions of drainage. During 1918–19 he was Chairman of the Nile Projects Committee of the Foreign Office; from 1917 to 1919 Chairman of

the Canal Control Committee of the Board of Trade; and in 1919 Chairman of the Treasury Committee on Aerodrome Accounts. He was a member of the Royal Commission on Fire Prevention, of the Advisory Council of the Science Museum from 1915 to 1921, of the Advisory Council on Scientific and Industrial Research, and of the International Technical Commission, Suez Canal. He was also Lieut.-Colonel in Command of the Engineer and Railway Staff Corps.

For his work on the Assuan Dam, Sir Maurice received the Order of the Mejidieh, 2nd Class, in 1901, and was created C.M.G. the following year. He held the honorary degree of LL.D. of Birmingham University, and had been a Fellow of the Royal Society since 1919. He entered the Institution of Civil Engineers as a student, became an associate member in 1887, was transferred to the class of member in 1893, and was President in 1916. His presidential address, which dealt in the main with the difficulties which had to be overcome by engineers in their work, was one of the best of recent years. He received for contributions to the Institution's "Proceedings" the Telford and Watt Medals, a Telford Premium and a Miller Prize. He was also a member of the Institution of Mechanical Engineers, an honorary fellow of the Society of Engineers, an honorary member of the Royal Engineers' Institution, a member of the Canadian Society of Engineers, and Vice-chairman of the Institute of Transport.

A New System of Driving Ship and Other Auxiliaries.

On Tuesday, November 18th, Mr. Gilbert Austin read a paper before the Institution of Engineers and Shipbuilders in Scotland on a new electric drive for ship and other auxiliaries. The paper describes a new constant-current system, in which the current for the auxiliaries is produced by a generator with fixed brushes, and the voltage varies automatically according to the external load. In the diagram, Fig. 1, the armature of the generator is shown at 11 and the separately excited field magnets at 12.

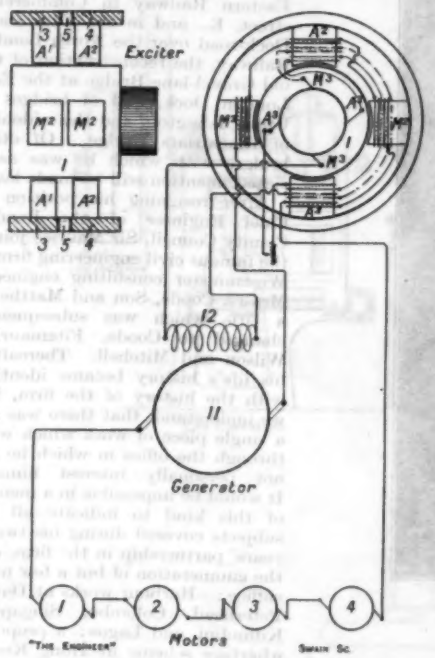


FIG. 1—GENERAL SCHEME OF CONNECTIONS

An exciter is coupled to the generator shaft, or it may be driven independently. The main motors are shown at 1–4.

As indicated in the upper part of the diagram, the exciter has a single armature 1, main poles M_2, auxiliary poles A_2, main brushes M_2, and auxiliary brushes A_2. The windings on the main poles carry the main current or a portion of it. The auxiliary poles are provided with three separate windings—an exciting winding deriving its supply from the auxiliary brushes A_2, a compensating winding in series with the generator field magnet coils, and deriving its supply from the brushes M_2, and a stabilising winding carrying the main line current. The auxiliary poles are split into two portions A_1 and A_2, and the exciting and compensating windings which embrace the whole pole are connected so that they both excite in the same direction. The stabilising winding is wound round one part of the pole in a direction which makes it assist the other two windings, whilst on the other part of the pole the winding opposes these windings. The yoke of the machine is also divided into two parts 3 and 4 by a ring of non-magnetic material 5.

The action of the machine is as follows:—Currents flowing from the main and auxiliary brushes set up magneto-motive forces in the armature of the exciter in line with their respective brushes. The magneto-motive force in line with the main brushes opposes the flux produced by the exciting winding on the auxiliary poles, whilst that in line with the auxiliary brushes opposes the flux of the windings on the main poles. As the magneto-motive force produced in the armature by the current from the main brushes opposes and weakens that of the exciting winding on the auxiliary poles, it is compensated by means of the compensating winding on the auxiliary poles, so as to assist the exciting winding. The stabilising winding is wound so that it partly assists and partly opposes the other two windings.

One part of a pole is strongly magnetised, and is insensitive to small changes, whilst the other part is almost in a neutral state. This part therefore has a high permeability, and is very sensitive to the slightest change. If the current flowing in the line is of such a value that the flux from the main poles almost balances that in the armature due to the current from the auxiliary brushes, then there will be practically no flux in the main poles, and therefore only the very small voltage required to excite the generator fields under short-circuited line conditions will appear at the exciter main brushes M_2.

If, however, the line current falls slightly, a three-fold effect will be produced, which tends to increase the exciter main flux, and therefore the field of the generator in the following manner:—(1) The armature reaction magneto-motive force in line with the auxiliary brushes becomes greater than the magneto-motive force due to the exciter main poles, thus producing a residual magneto-motive force in favour of the armature. (2) The opposing magneto-motive force due to the stabilising winding on the auxiliary poles is reduced, thus further increasing the residual magneto-motive force by increasing the auxiliary brush current. (3) Owing to the increase of the auxiliary brush current and the corresponding increase of the exciting magneto-motive force on the auxiliary poles, the auxiliary

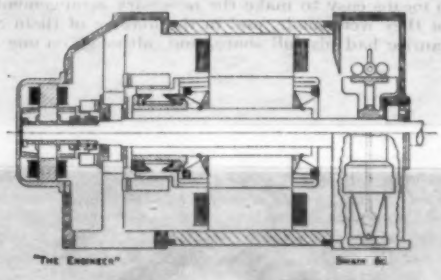


FIG. 2—LONGITUDINAL SECTION OF MOTOR

brush current is still further increased, and that results in a still greater increase of the residual magneto-motive force referred to under the first heading.

This three-fold effect is obtained with great rapidity, and with little or no mutual inductive action between the various adjacent windings, and if the line current is increased instead of being reduced, the arrangement operates in the reverse direction. In the event of a sudden great increase in the line current, the cumulative effect of the three windings on the one part pole holds the machine in a stable condition by preventing the reversal of the magnetism of the auxiliary poles as a whole.

The practical effect of the arrangement is that an ammeter in the main line circuit shows practically a steady current, whilst a volt meter connected between the positive and negative terminals indicates a pressure which varies with the load.

A sectional view of a motor designed to run with fixed brushes and with variable voltage is shown in Fig. 2. The machine consists of a combination of a large and small motor, the two armatures being on the same shaft. The small motor is known as the regulating motor. The line current passes through the armature of the main motor and the field winding of the regulating motor, whilst the armature of the latter is connected in the field circuit.

A diagrammatic sketch of the arrangement in its simplest form is shown in Fig. 3. The main line, consisting of a single conductor 2–3 is connected to the middle point of a double-pole short-circuiting and disconnecting switch

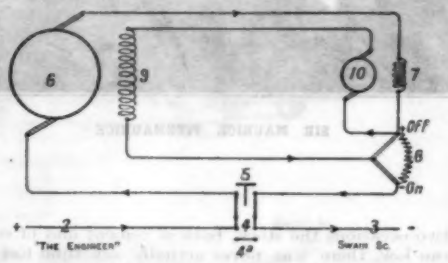


FIG. 3—MOTOR CONNECTIONS

4. In the off position the switch blades are short-circuited by the connection 4A, whilst in the on position the switch blades connect the line to the motor, the change over being produced without interrupting the main circuit. A neutral point contactor 5, operated mechanically by the control lever, is provided for the purpose of short-circuiting the motor in the off position of the controller. When contactor 5 is closed the line in circuit is completed, but the motor is put out of action. But when the contactor is open as shown the current flows through the armature 6 of the main motor, the field magnet 7 of the regulating motor and the resistance 8 of the potentiometer regulator to the negative section of the line 3.

The value of the resistance of the potentiometer 8 gives a drop of a few volts between its terminals, and the field magnet windings 9 of the large motor and the armature 10 of the regulating motor are arranged in series, the complete circuit being connected as a shunt to the potentiometer regulator 8. When the contact arm of the potentiometer 8 is at the off position the contactor 5 is short-circuited and only a comparatively small current will flow through the motor armature, depending upon the relative conductance across the contacts of 5 on the one hand, and the circuit 6–7–8 on the other.

As soon, however, as the control lever is slightly advanced the contactor 5 opens circuit and the current flows through the main armature 6, the regulator 7 and the potentiometer 8 to the negative part of the line. If, now, the contact arm of 8 is advanced, say, to the full-on position as shown there will be a difference of potential of a few volts at the terminals of the derived circuit 9–10, and this will be sufficient to induce the full load exciting current to pass from the positive end of the potentiometer through the armature 10 and the field winding 9 to the negative end. If the position of the control lever be varied the potential difference at the terminals of the derived circuit will vary and the value of the current flowing through the field magnet system will vary correspondingly.

The armature 10 of the regulator is connected so that any voltage which it may produce will oppose that from the potentiometer. The author describes an alternative method whereby the potentiometer 8 is replaced by a regulator which is connected as a shunt to a portion of the line containing resistance, and also an arrangement suitable for the control of a reversible motor. Two methods of making a motor run at constant speeds are also described.

With this new system, in which the current is kept constant whilst the voltage varies in accordance with the load, fuses, and the usual switchboards, resistances and controllers are dispensed with and speed control and reversals can be carried out with ease and safety. Of all machines which an electric motor is called upon to drive winches are perhaps the most exacting. With this new system, however, the usual difficulties are overcome. There are no resistances to absorb power or burn out, no circuit breakers or fuses are employed. The speed can be controlled perfectly up or down, and the motor cannot be overloaded or be burnt out by excess current. The motor will maintain full tension on the rope for any length of time with the armature at a standstill, and will take up slack automatically, the load can be held in mid air without the use of a brake. Under certain conditions the descending load will drive the motor as a generator and return power to the line. The foot brake can be applied at any time and the motor can be brought to a standstill whilst the power is full on without damage to the motor or speed regulator. The speed is under the control of the operator, and it is also automatically limited to correspond with the weight being lifted, the lighter loads being moved at higher speeds than the heavier loads.

For driving other auxiliaries the scheme is also shown to offer very considerable advantages, and a good deal of waste associated with the constant voltage system is avoided.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

"VIBRATORY BOUNCING."

Sir,—I should be glad to know of any experimental or theoretical investigations of the problems of vibratory bouncing—the type of case being that of a loose object resting on a vibrating surface so that it is thrown into the air and thus for a part of the time is independent of the imposed motion.

Although the phenomena of vibration, forcing, resonance, beats, &c., are familiar and well-studied matters of the text-books, the associated cases of vibratory bouncing do not appear to have been described in detail. Such phenomena as the chatter of loose parts, pulsations of partly detached mechanism, *e.g.*, cams, pawls, ratchets, loose pulleys, riders, factory windows, couplings, &c., are the only too well-known bugbears of engineers and probably have received treatment.

The experiments of Dr. W. N. Bond, of Reading University College—see *Nature*, February 7th, 1924. "Trans." Lon. Phys. Soc., April 11th, 1924—in which a vibrating tuning fork brought into contact with sound boards, was made to elicit sub-harmonics down to that of one-fifth of its own frequency, called my attention to this case of inversion of Fourier's theorem, and on searching for the literature on the subject I was rather surprised to find nothing bearing on the case. I am indebted to the kindness of Professor G. N. Watson, of Birmingham University, the secretary of the London Mathematical Society, who was good enough to ask a colleague to make the search, and who replies:—"I know of no work bearing on the problem other than the theory of Hertz. Crelle, Bd. XCII., 1882, for the stress distribution in two spherical bodies in contact. This, however, has only a secondary bearing. . . I am afraid this is all I can suggest, although I agree that the problem sounds interesting."

An examination of an idealised case leads to nothing more than might have been inferred by anyone versed in dynamics, but it may interest the reader to note some of the conclusions arrived at. The varied conditions of practice are much too general to allow of description, but by assuming an idealised case the conditional factors are observable.

(1) Horizontal surface vibrates vertically in cycles of definite period. The driving force is considered great in respect to any reactions.

(2) On the plate rests an ideal ball, both ball and plate being of great rigidity and resilience, so that there is no dissipation of energy on contact; the ball rebounds without loss of velocity or appreciable time, and the internal motions, rotations and deviations of the ball are negligible.

(3) There is no dissipation of energy during jump.

In order to ascertain the "jump time" of the ball we equate the motion of the plate to free motion of the ball under gravity, and obtain thus a transcendental equation, which can be numerically or graphically approximated, but no formal solution appears possible, nor is there any way of evading the difficulty.

By differentiation of the equation we derive the equations of coincident velocity and acceleration.

The former, in conjunction with the positional equation, defines the ball coming to rest asymptotically on the plate, *i.e.*, with no velocity, and therefore on condition that any cycle of jumps is terminated. The latter equation defines the phase and critical frequency at which the ball will start jumping off the plate, the one-sided constraint of the plate limiting the position of this jumping-off the plate to the upward loading quadrant. It is interesting to note that with an amplitude of 1 cm. the critical frequency is about 5 vibs./sec.

These three equations enable us to find, at least theoretically, the jump-time, the initial phase and velocity, and a factor of the terminating jump of a group of jumps. The original positional equation may be described in words:—

There is a unique "jump-time" during which the absolute travel of the plate minus the distance travelled under the initial

impulse plus the distance of free fall under gravity equals zero; or, on dividing through by J we have:—Mean velocity of plate from initial to final positions minus velocity due to original impulse plus mean velocity of fall due to gravity equals zero.

From such an original equation the equations of successive jumps can be formed by inserting the position and velocity terms. It is to be observed that the velocity of arrival on the plate is reversed by reflection and is added to the local velocity of the plate. The equations are naturally somewhat cumbrous, but can be formally reduced.

By adding successive equations the cross trigonometrical terms cancel, and we get an equation to determine the total time since start of jumps.

The condition that the velocity coefficient vanishes determines the return to the initial condition *when the ball falls outside the critical phase region*. But if it falls within this region it immediately starts on a new cycle of jumps with new coefficients. The limit of phase to starting jump, with a plate slowly speeded up is $\pi/2$. Here the ball is just leaving the plate with no velocity. When the plate arrives at "infinite" frequency the point of departure has crawled forward to zero phase, and at this point the ball cannot get away with its "infinite velocity." These two paradoxical points therefore mark the asymptotic limits of the possible range. The velocity of the jumps may be derived by the transformation of phase (sine to cosine) by the right-angle rule.

In any case, it is to be noted that our independent variables, amplitude and frequency, cannot be reduced, because they are related differently on the harmonic and linear sides of the equation. This complicates the question, but we can always choose units in *one* of these variables. The general propositions of the case are fairly obvious, viz.:—

(1) If the ball jumps from any crest/trough to any one crest/trough, it (in the ideal case) continues to do so.

(2) This condition can never be reached by finite steps from any other phase, for there will always be a small excess or defect, which will recur at the next jump. But the condition may be attained asymptotically after an infinite number of jumps, when, as before remarked, it keeps on for ever.

(3) If the ball falls just short of a crest it receives an increment of velocity tending to extend the jump, and bring it nearer to the next crest or beyond it. If it overshoots the crest the opposite happens, and the ball shortens its next jump, tending to retreat to or within the next crest.

Exactly the opposite happens in the neighbourhood of the troughs, so that the conditions are favourable to the convergence of the ball to the crests, and its divergence from the troughs. Under conditions which permit of retention in the respective neighbourhoods this tendency to gather to the crests and avoid the troughs leads to a kind of "quantisation" of the jumps in multiples of the plate period, *i.e.*, to the sub-harmonic series of Dr. Bond, and it is clear that if by resonance any of these sub-harmonic frequencies became evident we would have a condition which would affect the engineering aspect.

The case where the ball jumps from any other phase to the same or oppositely signed phase is of interest. In the first case, it increases its periodic jumps successively one, two, three, four times the original multiple of plate period. In the second case, it is reduced to rest and cannot get away from the plate again until the critical phase is reached. If, therefore, the conditions are such that this latter case is reached the ball thus makes a fixed jump of twice the "complementary" phase and completes a period which is a multiple of that of the plate by a *resting time* which is always less than the jump time.

We thus have a case of forced intermittent vibration. If the ball, during its series of jumps, lands on crest or trough, it reverses the previous series of jumps. These points, therefore, act as "mirrors," and thus when either point happens to be reached in the course of a cycle of jumps it is the middle point of such cycle.

As a particular case we may note that a ball thrown off at critical phase with the appropriate velocity, if it happens to jump one plate period, the amplitude for one vib./sec. is about 50.6 cm. and the frequency for 1 cm. of amplitude is about 44.67 vib./sec.

If dissipation be introduced into the problem the conditions become complicated. It is possible to use the artifice of retaining the "parabolic" path of jump with a small fractional deduction of velocity at each jump.

In this case, if the velocity so dissipated equals that communicated by the phase of the plate, and if the jump is of an integral multiple of plate periods, it remains steady, but whether it is stable for small deformations from the exact path it is not possible to say in the general way.

If there is dissipation the amplitude of forcing will decrease exponentially and thus pass through a singular point as above, and thus the series of jumps of the period of the plate, or a sub-multiple of that value, will be initiated and may persist long enough to become not only perceptible, but possibly dangerous to structures. This is the case on which the views of those who have studied the matter would be interesting.

In practice we should probably not have simple harmonic "cyclons" to deal with, but Fourier sums of the same. It would be interesting to know if Dr. Bond, in calling attention to this class of phenomena by his special cases, is the first in the field.

JOHN L. DUNK.

Folkestone, November 18th.

ONCOST.

SIR,—The remarks of Mr. Ralph E. Flanders, which you commented upon in your issue of the 7th inst., seem to suggest a re-examination of the general principles of costing, particularly in regard to the distribution of the "overhead." This subject has not received the attention by British engineers which our American colleagues have given to it, as witness the excellent papers of Mr. H. L. Gantt and Mr. Walter Polakov, published in the "Proceedings" of the American Society of Mechanical Engineers; but it cannot be supposed that there are fewer "sore heads" caused on this side over the problem.

"Overhead" as a factor in costing is always threatening rupture between the engineer superintendent and the accountant staff. The accepted system of financial accountancy requires that all factory expense, however large, shall be borne by the output, however small, even though a large part of that expenditure may not be incurred in respect of the product or its delivery. This system, H. L. Gantt observes, "has been devised by accountants and financiers, whose aim has been to criticise the factory and make it responsible for the shortcomings of the entire business. In this they have succeeded largely because the methods used are not devised to allow the superintendent to present his side of the case." On the other hand, he claims that "the true purpose of costing is to enable the superintendent to know *whether or not he is doing the work he is responsible for as economically as possible*." The distinction between an accountant's and an engineer's conception of costing forces itself home when a plant is running on low output and the whole "overhead," including idle as well as running plant, with possibly an added factor due to unsound financing, is costed against the product. If the product does not sell there is trouble—for the engineer! The attempt to make the product bear the expense of plant or other expenditure not needed in its production is the most serious defect in our industrial system to-day, and further reaching than the differences between employers and employees.

It must be clearly borne in mind that the costing system, however accurate and however efficient, is only a means to the end of maintaining a steady market for the plant. It is too often assumed that no further consideration is involved when all charges have been covered somehow, that the rest of the contract remains with the purchasers; and certainly if industry were only a £1 a day concern such an attitude might have been condoned. Modern industry, however, is far too great, the public interest and dependence on it as producers and consumers far too urgent, to permit us to leave a void between the ability to produce and the ability to purchase the product. It may very well prove that an examination of the ability of the public to sustain effective demand for industrial products is the most profitable field for inquiry if manufacturers are ever to establish the *right to sell* what they have equipped themselves to produce. It is an axiom that the ability of producers to dispose continuously of their products of full capacity at remunerative prices is dependent upon the ability of the consumer to purchase continuously those products. Any failure of *the rate* of financing the public as purchasers immediately reacts on sales and therefore on *the rate* of production.

The conception involved is essentially dynamic as production is a flow to be steadily sustained, not a single act. But in the final analysis the consumers' resources, *i.e.*, incomes, are wholly derived from production because there is simply no other source, and consequently every income is a cost on some product. It would seem then at first glance that an automatic balance was established between production and ability to purchase; so much money is distributed in production, therefore, that much money is available for purchase. But this assumption is absolutely invalidated by two objective facts:—

(1) That the public has not the money to buy the product when it is put on sale; otherwise the present industrial depression is a dream and a delusion.

(2) That industrial production is almost entirely financed on bank credit for its inception and continuance.

Indeed, the paradoxical features of the present situation are that manufacturers who are vainly trying to induce an impoverished but otherwise willing public to purchase their output are themselves being pressed by the banks to reduce their overdrafts.

The explanation of such a situation will be extremely interesting, but I venture to suggest that it establishes *a primâ facie* case for investigation, and an extension of the science of costing into the sphere of buying. I will hazard the guess that this curious result is an effect of the continued practice of costing of overheads for idle plant, &c., for this is clearly an item in selling price which is not represented by any equivalent distribution to the public. Is it not conceivable then that the ultimate resultant that this costing of ineffectives through all successive stages of industry down to the point of final purchase by the consumer has inflated minimum cost price of ultimate output far above the resources of the public as purchasers? A.

November 13th.

SIR,—The leading article entitled "Oncost," which appeared in your issue of Friday, November 7th, contained certain advice which, though valuable at any time, is particularly opportune at the present juncture, when many engineers feel that they are about to witness a period of better trade. The examples which you gave were, however, based upon American practice, so perhaps I may be permitted to quote a few figures illustrative of the present-day state of affairs in this country, as they go far to confirm and, I think, strengthen the chief points of your leader.

Even in this country, where mass production on a large scale has not been organised to the same pitch that is now common in the United States, the proportions of "Oncost" to direct labour shown below indicate that oncost is deserving of the closest attention. The figures represent factory establishment charges only and include no allowance for selling or general administrative expenses.

	Direct labour.	Factory establishment charges.
A switchgear factory ..	100	120
A steam engine factory ..	100	127
A foundry	100	130
A forge	100	185

You also draw attention to the importance of segregating the cost of selling and distribution from the cost of manufacture. The advantages of making this distinction seem to be but imperfectly realised by many manufacturers, though one has but to think for a moment of the cost of advertising to appreciate the point. An advertising campaign is generally undertaken with the object of increasing turnover and thereby reducing the proportion of establishment charges in the cost of the product. Now, advertising is a selling expense, but if selling expenses are not segregated from factory establishment charges, there will be no means of discovering to what extent a rise in the selling expense caused by increased advertising has resulted in a reduction of the proportion of factory establishment charges. To commence with, at all events, an increase in the one will tend to mask a saving in the other.

Another item of selling expense is the cost of preparing estimates. Not long ago tenders were invited for certain machinery valued at about £500, and some twenty-eight different firms submitted quotations. The preparation of an estimate, as engineers will appreciate, is specialised work and it takes considerable time, so it will be no exaggeration to assume that it cost each of the twenty-eight firms at least £2 to prepare their quotations. If these proportions can be considered normal, each of the twenty-eight firms will receive one order for every quotation it submits, which means to say that it will spend £56 on estimating alone in the endeavour to obtain £500 worth of business!

Selling expense, containing items of such magnitude, cannot be ignored, but its true significance can never be really appreciated so long as it is allowed to remain mixed up with factory cost.

F. A. R. PATON.

Manchester, November 18th.

THE POST OFFICE TUBE RAILWAY.

SIR,—Your correspondent "Fenland" will find that the former tube railway worked by pneumatic propulsion was fully dealt with in THE ENGINEER of June 2nd, October 6th, and 13th 1899. The subject is also dealt with in Professor Pepper's "Encyclopædic Science" and Mr. Robert Routledge's "Discoveries and Inventions of the Nineteenth Century." In both works the same woodcut showing some cars at the mouth of a tunnel are used, the only difference being that in the former work quoted passengers are shown making the journey, whilst in the other mail bags are shown.

The articles in THE ENGINEER state that a proposal to work the line by electricity was made and that Mr. George Threlfall was appointed engineer to the new company. *Engineering* mentions in its issue of September 22nd, 1899, "that the new company went under the title of the London Dispatch Company, with Mr. Threlfall as engineer, and his offices were at 50, Fenchurch-street, E.C. The plans for the electrical equipment of the line are now being prepared by Professor Carus Wilson, and we hope to describe the plant in detail at a later date."

A search at Somerset House in the room for registration of companies would reveal whether the company formed in 1899 is in existence or not.

Providing the tube has not depreciated by decay since your articles appeared in 1899, there is every reason to believe that it is still in existence, but its limited width and height would be against its carrying bulkier weight than mail bags.

Since the articles appeared in your issues and your confrère *Engineering* I have seen no further reference to the tube.

London, November 16th. A. M. BURRELL.

THE FUTURE OF THE LOCOMOTIVE.

SIR,—The admirable and encouraging leading article on "The Future of the Locomotive," in your issue of November 14th, ends with an appeal to British builders of locomotives to maintain the tradition for progress and initiative, which this country held for so long in railway technique, and deplores the inertia which is rapidly leading towards a repetition of the history of the marine internal combustion engine, where 90 per cent. of the engines are built in this country under foreign licences and are dependent—except for improvements—on foreign brains.

You point out, I fear with justice, that little progress has been made with the two types of British origin, namely, the Ramsay steam turbine locomotive and the Still combined internal combustion and steam locomotive; this has not been for lack of trying on the part of the originators, and I can speak with knowledge in saying that a patriotic policy of endeavouring to get the latter taken up in this country in advance of the Continent has been ill-rewarded.

However, as noted in the "Seven-day Journal" of your issue of September 26th, 1924, the historical firm of Kitson and Co., of Leeds, are at present building the first main line locomotive on the Still system, but they are the only firm to give a lead in this country; and with the originators they have had to bear the whole load and expense of this pioneer work, meeting with little encouragement and no active support or assistance, either from railway companies or from the Government, which, if this country is to retain its pioneer position, they would surely have been justified in expecting and would have received elsewhere.

If I might trespass further on your space, I would have liked to deal with the practical objections in complications, weight and cost to the adoption of electric—or even pneumatic or hydraulic—systems for obtaining variable transmission, but I feel that the article and drawings on the Lomonosoff Diesel-electric locomotive in your current issue afford full illustration of these points, and would only ask to be allowed to correct your remark that "No one has ever even faintly adumbrated what might be called a practical design of internal combustion locomotive with the engine geared direct or by fixed reducing gear to the axles." This is exactly what the Still design accomplishes, the latter type being embodied in the Kitson locomotive and the former in the designs now being produced in conjunction with MM. Schneider et Cie.

H. A. D. ACLAND, M.I. Mech. E.

The Still Engine Company, Limited,
7, Princes-street,
Westminster, S.W. 1.

[We are familiar with the Kitson-Still design and we submit that it cannot be regarded as an exception, for it is by virtue of its qualities as a steam engine rather than as an oil engine, that it is able to dispense with variable speed gear.—ED. THE E.]

WIRE NETTING MACHINE.

SIR,—I have read your article in the August 29th issue with much interest, and should like to put on record the able manner in which the writer has tackled the difficult problem of describing and illustrating in diagram a most fascinating piece of complex mechanism.

About twenty years ago I also was afforded a similar opportunity of inspecting one of these weaving machines at Messrs. Boulton and Paul's works, Norwich, and well remember the thrill of admiration I felt for the man who first evolved the simple-when-you-know-it expedient of arranging for the wire-holders to change partners at the proper time. Could he have unconsciously applied the near parallel of the *finale* in the first figure of our English quadrilles, for in two essential features the movements are alike, though in the case of the "twist," etiquette then demanded a clockwise direction only.

A point in the manufacture of wire netting I entirely overlooked, until I had actually seen it made, was that the rows of twists were alternately right and left hand. I suppose many others like myself had assumed the twists to be uniform, and suffered from the same difficulty of trying to solve what happened in the mechanism that prevented the wire coming from the bobbins being repeatedly broken. In actual practice it is obvious that the "bobbin" wire is not permanently twisted on itself at all, as the direction of rotation is constantly reversed. In the case of the "spring" wire the natural twist, due to it being drawn from the inside, like the "string ball" is unwound in one direction, but gets a double stress in the twist of the other, in the region where both wires are laid up together. In either case the wires are only locally stressed for short distances and have no special reason for complaint.

I wonder how many engineers realised the obviously simple trick of cleaning off the superfluous zinc by drawing the netting through a thick layer of broken coke lying on the surface of the metal bath. I had always pictured the practice prevailing in the tin-plate trade, viz., boys with housemaids' brooms—but ashes, never!

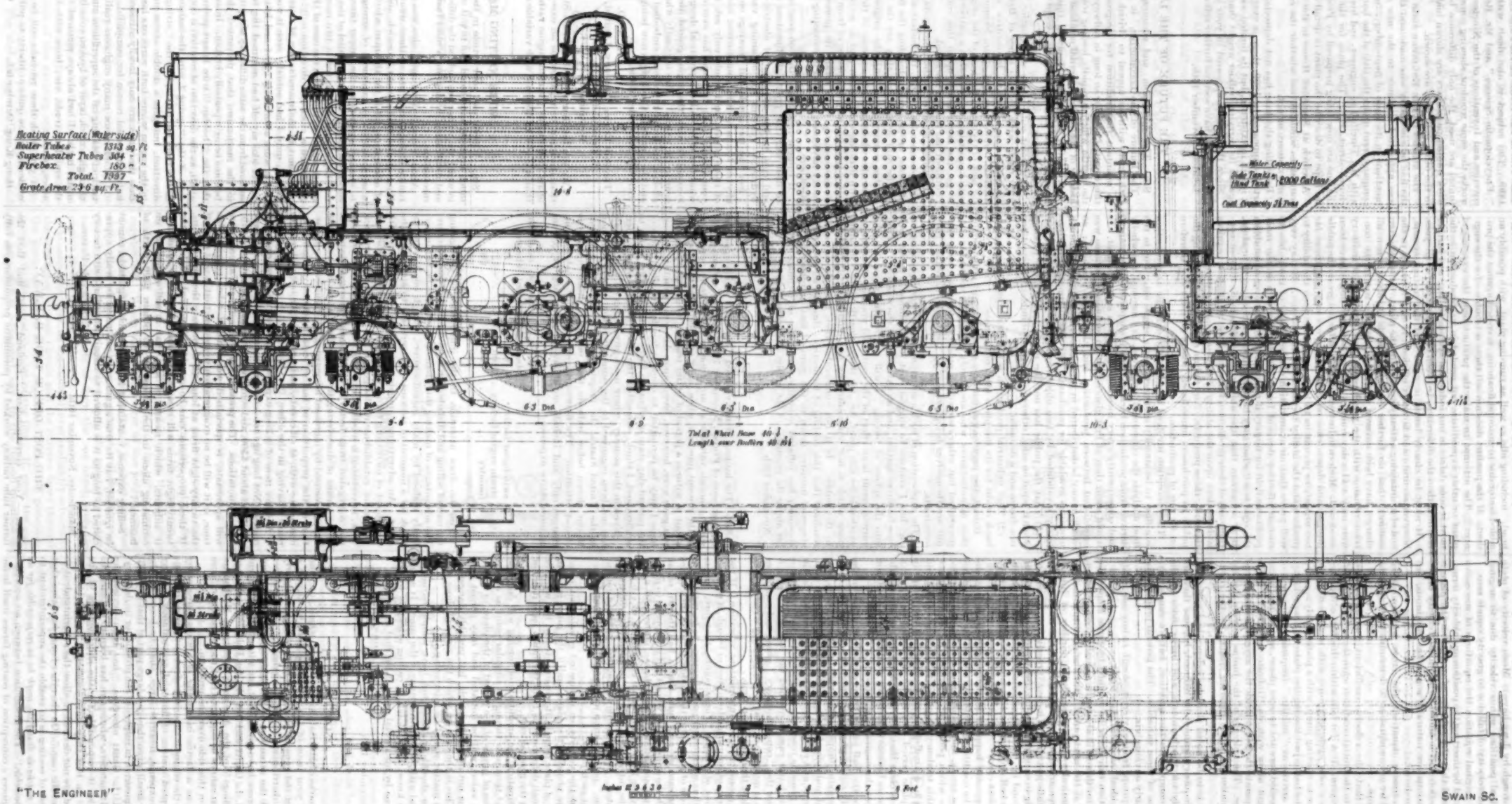
If you think these remarks will be of any interest to other readers, you are quite at liberty to publish this letter.

Hong Kong, October 6th, CONRAD F. MENDHAM.

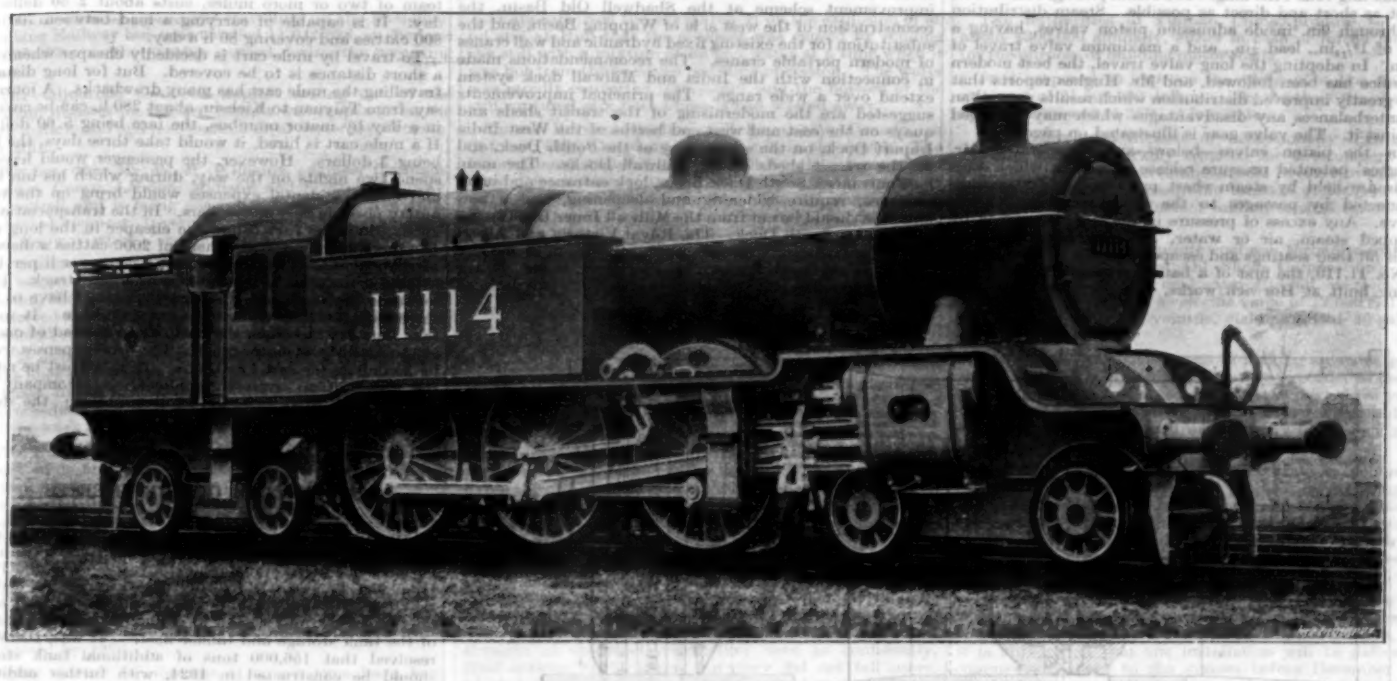
LONDON, MIDLAND AND SCOTTISH RAILWAY—FOUR-CYLINDER TANK LOCOMOTIVE

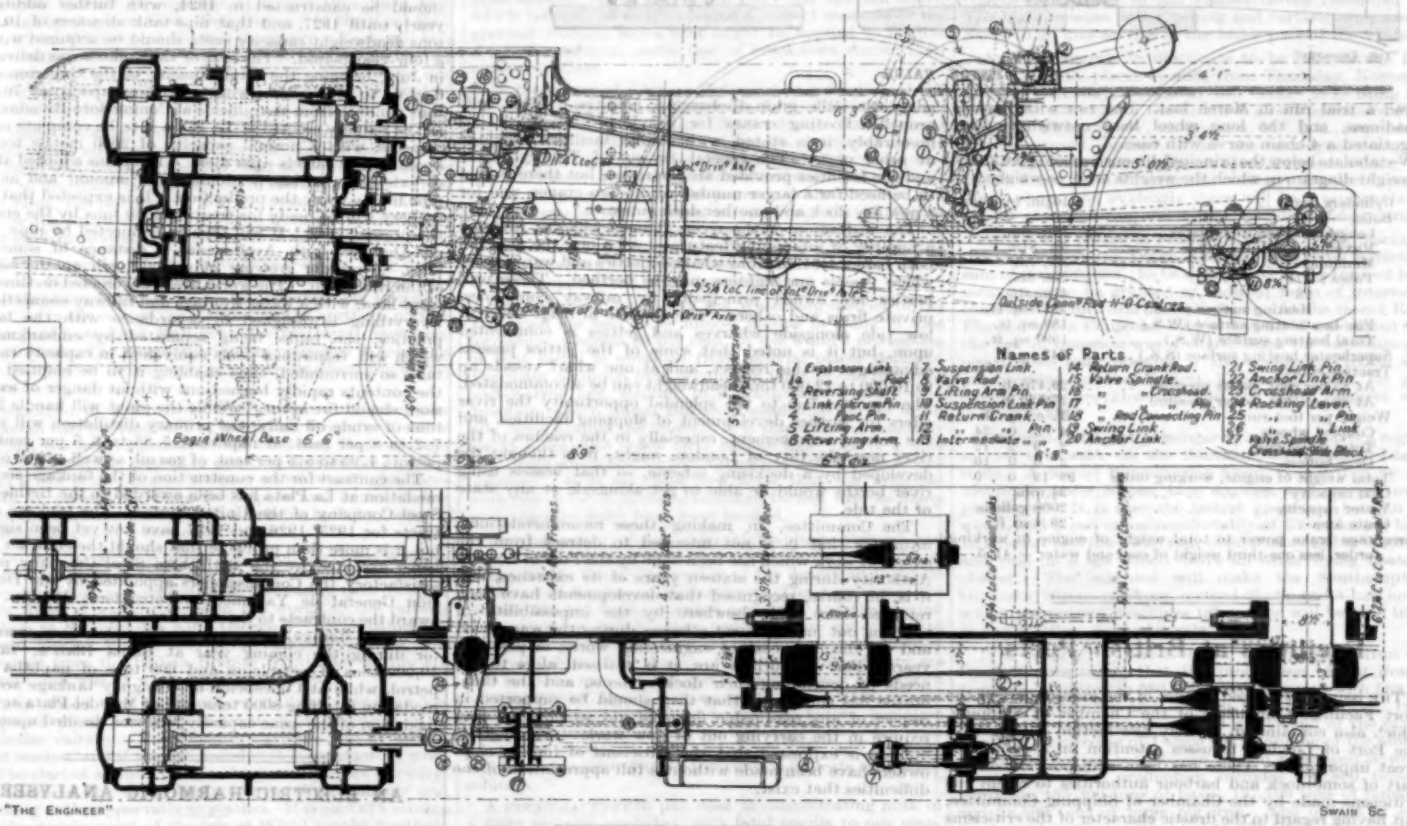
GEORGE HUGHES, M. Inst. C.E., HORWICH, ENGINEER

(For description see opposite page)



L.M.S. RAILWAY—BALTIC TANK LOCOMOTIVE



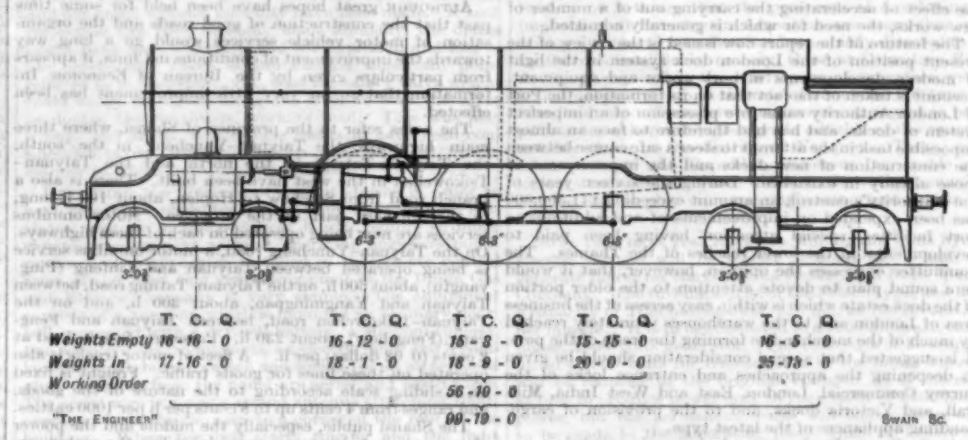


L.M.S. Rly.—"Baltic" Tank Engines.

Mr. Hughes has built at Horwich several four-cylinder tank engines, intended to be used for heavy suburban traffic over severely graded lines where great accelerative power is needed. At the same time they may be called upon to haul express residential trains up to about 50 miles radius, so as to release 4–6–0 tender engines from this service for main-line work. The fifth of these engines, No. 11,114, is illustrated above, and a drawing is given on page 582.

The Horwich-built four-cylinder superheated 4–6–0's with 6ft. 3in. wheels have proved themselves over an extended period to combine the capabilities outlined above with economy in running and upkeep expenses, so that in producing the tank engine as little departure as possible has been made from the design of these 4–6–0's. The frames have been lengthened at the rear to take the bunker and trailing bogies, the wheel base has been lengthened somewhat to comply with permanent way restrictions, and the grate area of the fire-box has been increased from 27 to 29·6 square feet.

The superheater employed is the "Horwich" design, commonly known as the "top and bottom header" superheater, designed by Mr. Hughes. In it the elements are placed in a vertical position down each side of the boiler, instead of horizontally, as in most other types. Separate cast iron headers are used for the saturated and superheated steam, those for the latter being bolted directly on to the cylinder castings, thus doing away entirely with intermediate steam pipes, and having the advantage that the saturated steam has no opportunity of exerting any cooling effect on the superheated which may happen when both are in the same header. By this arrangement it is claimed also that a more even distribution of temperature in the tubes results, so that trouble with leaking flue tubes is greatly reduced. There is another design of Horwich superheater, also designed by Mr. Hughes, known as the "twin plug" type, which is somewhat similar in arrangement, but has the advantage that each element may be removed without disturbing any of the others, but in every-day running the "top and bottom" type is found to be more satisfactory.



	T. C. Q.	T. C. Q.	T. C. Q.	T. C. Q.	T. C. Q.
Weights Empty	16 - 16 - 0	16 - 12 - 0	15 - 8 - 0	15 - 15 - 0	16 - 5 - 0
Weights in Working Order	17 - 16 - 0	18 - 1 - 0	18 - 9 - 0	20 - 0 - 0	25 - 13 - 0
			56 - 10 - 0		
			99 - 19 - 0		

"THE ENGINEER" SWAIN Sc.

The cylinders are in three separate castings, individually

bolted to the frames, the inside pair driving the leading coupled axle through connecting-rods 6ft. 8in. long, and the outside pair driving the intermediate axle through connecting-rods 11ft. long. The steam passages have been kept as short and direct as possible. Steam distribution is through 9in. inside admission piston valves, having a lap of $1^3/_{16}$in., lead $\frac{1}{4}$in., and a maximum valve travel of 6$\frac{1}{2}$in. In adopting the long valve travel, the best modern practice has been followed, and Mr. Hughes reports that the greatly improved distribution which results more than counterbalances any disadvantages which may be urged against it. The valve gear is illustrated on page 583.

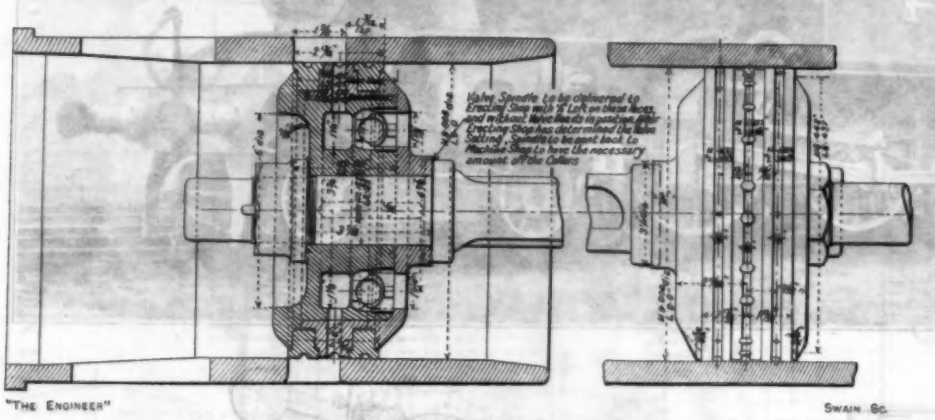
In the piston valves—below—are incorporated Mr. Hughes' patented pressure release valves, in which steel balls are held by steam chest pressure against seatings connected by passages to the outer periphery of the valve. Any excess of pressure in the cylinder caused by trapped steam, air or water, automatically forces the balls off their seatings and escapes into the steam chest.

No. 11,110, the first of a batch of ten of these engines being built at Horwich works, was put into steam and given a trial run in March last. She ran with notable steadiness, and the long wheel base notwithstanding, negotiated a 4-chain curve with ease.

We tabulate below the principal dimensions and give above a weight diagram in which the weights are "as weighed."

Cylinders (four)	16½in. by 26in.
Boiler—	
Length between tube plates	14ft. 8in.
Maximum inside diameter	5ft. 8¼in.
Minimum	5ft. 7in.
Tubes: 171	2in. dia.
28	4½in. dia.
Heating surface (W.S.)	1817 sq. ft.
Fire-box heating surface (W.S.)	180 sq. ft.
Total heating surface (W.S.)	1997 sq. ft.
Superheater heating surface (S.S.)	343 sq. ft.
Tractive effort—	
At 85 per cent. boiler pressure	29,470 lb.
At 80 per cent. boiler pressure	27,736 lb.
Weight per foot run—	T. c. q. lb.
Coupled wheels	4 3 0 24
Total wheel base	2 9 2 12
Over buffers	2 0 0 10
Total weight of engine, working order	99 19 0 0
Coal capacity	3½ tons
Water capacity	2000 gallons
Grate area	29.6 sq. ft.

Percentage brake power to total weight of engine in working order, less one-third weight of coal and water = 41.5.


Valve Spindle to be skimmed up Erecting Shop with 'X' Left on these faces and without these Heads in position after Erecting Shop has determined the Valve Setting. Spindle to be sent back to Machine Shop to have the necessary amount off the Collars
"THE ENGINEER"
SWAIN Sc.

PISTON VALVE

Facilities at British Ports.

The issue of a revised edition of the main report of the Port Facilities Committee of the Chamber of Shipping, which also contains an entirely new section dealing with the Port of London, focusses attention on a subject of great importance. There has been a disposition on the part of some dock and harbour authorities to resent the criticisms made by the Chamber of Shipping Committee, but having regard to the drastic character of the criticisms made by foreign ship-owning organisations of the facilities provided at British ports, there is general agreement that the Committee has done excellent service and has placed on record a number of interesting facts. It is probable, too, that the criticisms which have been made may have the effect of accelerating the carrying out of a number of new works, the need for which is generally admitted.

The feature of the report now issued is the review of the present position of the London dock system in the light of modern developments in port works and equipment. Account is taken of the fact that on its formation, the Port of London Authority came into possession of an imperfect system of docks, and has had therefore to face an almost impossible task in the attempt to steer a safe course between the construction of new docks and the improvement of those already in existence. During the sixteen years of the Authority's control, an amount exceeding £11,500,000 has been expended on improvements of and additions to port facilities, special attention having been paid to developments on the lower reaches of the Thames. The Committee expresses the opinion, however, that it would be a sound plan to devote attention to the older portion of the dock estate which is within easy access of the business area of London and to the warehouses ultimately reached by much of the merchandise forming the trade of the port. It is suggested that special consideration should be given to deepening the approaches and entrance locks of the Surrey Commercial, London, East and West India, Millwall, and Victoria docks, and to the provision of cargo-handling appliances of the latest type.

At the Surrey Docks a new dock area is now being constructed, and consideration is being given to the installation of electrically driven impounding pumps, which will maintain the water at Trinity high water level at all times. It is recommended that experiments should be made with pilers and conveyors for the handling of timber. The Committee recommends the reconstruction at the London Docks of the north side of the Shadwell New Basin, an improvement scheme at the Shadwell Old Basin, the reconstruction of the west side of Wapping Basin, and the substitution for the existing fixed hydraulic and wall cranes of modern portable cranes. The recommendations made in connection with the India and Millwall dock system extend over a wide range. The principal improvements suggested are the modernising of the transit sheds and quays on the east and west-end berths of the West India Import Dock, on the south quay of the South Dock, and all the transit sheds of the Millwall Docks. The main lock entrances, South Dock Basin, lock entrance and inner entrance, require widening and deepening, and a new entrance should be cut from the Millwall Inner Dock to the West India South Dock. The Royal Victoria and Albert and King George V. Dock are in the main a modern and well-equipped group. Criticism is made of the road approaches to this dock system, of the lack of adequate bulk grain-discharging facilities. The self-propelled floating cranes for heavy lifts compare unfavourably, it is stated, with similar facilities provided at other ports. The general lay-out of Tilbury Docks and the facilities provided are approved, but there is held to be need for a larger number of modern cranes, and for a new dry dock and another dock entrance.

The inspection of the river Thames wharves revealed a number of interesting features. All along the river on both banks are numerous wharves, jetties and warehouses, where vessels and lighters may be berthed. These properties are owned principally by railway companies, private firms and others. The absence of deep water at low tide alongside wharves and jetties is commented upon, but it is noted that some of the jetties possess advantages in this respect, and at one wharf vessels up to 10,000 to 12,000 tons deadweight can be accommodated. The report refers to the splendid opportunity the river offers for further development of shipping facilities, and the present arrangement, especially in the reaches of the river near the City of London, might, it is thought, be developed by a dockising scheme, so that vessels using river berths would be able to get alongside at any state of the tide.

The Committee, in making these recommendations, intimates that it is not intended to detract from the excellent work which has been done by the Port of London Authority during the sixteen years of its existence, and it is, of course, recognised that developments have been retarded here and elsewhere by the impossibility of carrying out improvement schemes during the war period and by the high cost of engineering works in post-war years. Port authorities are, it is realised, alive to the needs of developing their dock systems, and the Committee has considered that they should be supported in respect of any reasonable financial aid which they may require in the carrying out of new works. The definite opinion is expressed that the criticisms of foreign ship-owners have been made without a full appreciation of the difficulties that exist.

Motor *v.* Mule in China.

Although great hopes have been held for some time past that the construction of good roads and the organisation of motor vehicle services would go a long way towards the improvement of conditions in China, it appears from particulars given by the Bureau of Economic Information that so far very little improvement has been effected.

The notes refer to the province of Shansi, where three main highways, the Taiyuan–Yuncheng in the south, the Taiyuan–Tatung in the north and the Taiyuan–Tsikowchen in the west have been built. There is also a branch road from Sinchow to Hopien, about 160 li long, in the northern part of the province. Motor omnibus services are now being operated on each of these highways. On the Taiyuan–Yuncheng road, a motor omnibus service is being operated between Taiyuan and Linfeng (Pingyangfu), about 600 li, on the Taiyuan–Tatung road, between Taiyuan and Yangmingpao, about 300 li, and on the Taiyuan–Tsikowchen road, between Taiyuan and Fengyang (Fengshow), about 230 li. Passenger fare is fixed at 2 cents (0.02 dollar) per li. A fleet of motor trucks is also operated on these lines for goods traffic. Freight is fixed on a sliding scale according to the nature of the goods, and ranges from 4 cents up to 8 cents per li per 1000 catties.

The Shansi public, especially the middle and the poorer classes, are not, however, eager to utilise the motor services. They prefer the primitive mule carts, mainly owing to economic considerations. To them travelling by mule carts is almost 100 per cent. cheaper. A mule cart for passenger traffic can be hired at 1 dollar a day. It can carry one passenger and over 100 catties of luggage. The rate of travel is about 90 li a day. The hire of a bigger cart, specially constructed for goods traffic and drawn by a team of two or more mules, costs about 2.50 dollars a day. It is capable of carrying a load between 700 and 800 catties and covering 80 li a day.

To travel by mule cart is decidedly cheaper when only a short distance is to be covered. But for long distance travelling the mule cart has many drawbacks. A journey, say, from Taiyuan to Kiehsiu, about 280 li, can be covered in a day by motor omnibus, the fare being 5.60 dollars. If a mule cart is hired, it would take three days, the hire being 3 dollars. However, the passenger would have to spend two nights on the way, during which his inn bills and other incidental expenses would bring up the total outlay possibly to 4 or 5 dollars. In the transportation of goods, the mule cart cannot be cheaper in the long run. If a merchant sends a shipment of 2000 catties a distance of about 280 li, it would cost him 6 cents per li per 1000 catties, or in total 33.60 dollars, by motor truck. If he forwards the cargo by mule carts, he would have to hire three carts at 2.50 dollars per cart per diem. It would take four days to reach the destination instead of one, as in the case of the motor truck. The total expenses would be 30 dollars for cart hire alone. To this must be added the wages of an overseer employed to accompany the caravan. (1 catty = 1⅓ lb.; 1 li = 2115ft.; the dollar varies, but approximates to 2s.)

ARGENTINE OIL REFINERIES.

Considerable headway has been made with the erection of a refinery at La Plata in connection with the national oil reserves at Commodoro Rivadavia and Plaza Huincul. Early in the spring the Government decided that the extensive drilling campaign entered upon could only be carried out with a large increase in the capacity of the tank storage and tanker fleet. It was, therefore, resolved that 156,000 tons of additional tank storage should be constructed in 1924, with further additions yearly until 1927, and that nine tank steamers of 10,000 tons deadweight capacity each, should be acquired within a four-year period. The first of the tankers was delivered in July, bringing the total capacity of the Government's fleet up to 37,000 tons, with a carrying capacity of 70,000 tons a month from the oilfields at Commodoro Rivadavia.

The refinery erected at La Plata is to be complete in all respects, with a normal capacity of 2000 metric tons—about 14,000 barrels—per diem. The plans adopted allow of extensions to handle double that amount and an oil pipe line to carry the production. It is expected that the refinery will be ready for treating 1000 tons by the end of the present year. It will then be connected by pipe line *viâ* Quilmes, with Avellaneda—a distance of some 60 kilos.—a rapidly growing industrial town on the banks of the Riachuelo. The works are being erected on Government land, with a water frontage and railway connections. Everything is designed in accordance with the latest practice, the tanks being separated by embankments which will form open pools equivalent in capacity to the tank so surrounded, thus enabling it to be emptied and the contents rapidly burned out without danger of explosion, should fire occur. While the plant will handle 2000 tons of crude oil daily, the primary distillation will yield 7.2 to 8 per cent. of naphtha; 5.85 to 6.5 per cent. of petrol; 4.95 to 5.5 per cent. of gas oil, as well as fuel oil.

The contract for the construction of the tankage accommodation at La Plata has been awarded to the Bethlehem Steel Company of the United States. The tankage contracts for 1925, 1926 and 1927 have not yet been signed, but it is more than probable that should the contract now being executed by the Bethlehem Steel Company prove satisfactory the Commissioners appointed by the Dirrección General de Yacimientos Petroliferos Fiscales will award the contracts to the same firm.

Further storage tank accommodation has been arranged for during the coming year at Bahia Blanca, taking 10,000 tons of petroleum and 600 tons of naphtha and petrol, while at Concepción-del-Uruguay tankage accommodation totalling 8000 tons, and at Mar-del-Plata accommodation of the same capacity has been decided upon.

AN ELECTRIC HARMONIC ANALYSER.

At a recent meeting of the Institution of Electrical Engineers a paper was read on "An Electric Harmonic Analyser," by Messrs. J. D. Cockcroft, R. T. Coe, J. A. Tyacke, students, and Professor Miles Walker. After giving a brief outline of the existing methods, the authors described a modification of the dynamometer method, which allows a much greater degree of accuracy to be obtained than usual, and in which the properties of an oscillatory circuit are used to obtain a sinusoidal current wave of suitable frequency. This current is passed through one coil of a dynamometer, whilst the wave to be analysed passes through the other. The value of the coefficients in the Fourier series representing the wave form being analysed are obtained from readings of the dynamometer and an ammeter. The final method alluded to aims at analysing wave forms up to at least the twenty-third harmonic and correct to within 1 per cent. of the fundamental.

Institution of Automobile Engineers.—At a recent Council meeting of the Institution of Automobile Engineers, it was unanimously decided that the Institution Medal should be awarded to Dr. R. Ormandy in connection with the editing, checking and preparation of the matter for the report of the Empire Motor Fuels Committee, recently published as a volume of "Proceedings" of the Institution; to Mr. Geo. W. Watson for his paper on "Standardisation," which formed the subject of his presidential address before the Institution; and to Mr. H. G. Burford, for his services in connection with the co-ordination of the relations between the Institution, the S.M.M.T., and B.E.S.A. This medal was recently established to be awarded for any paper or similar service which may be considered likely to have a special influence on the advancement of automobile engineering.

Railway Matters.

The number of passengers travelling on the Shanghai-Nanking Railway last year totalled 11,042,228, an increase of 596,993 over the number carried during the preceding year.

The adjourned coroner's inquest arising out of the Lytham disaster on the 3rd instant was reopened on the 13th instant and again adjourned until yesterday, November 20th.

We hear that Mr. W. H. Williams, engineer for maintenance, Crewe, London, Midland and Scottish Railway, has retired and is being succeeded by Mr. A. Newlands, divisional engineer, Inverness, and engineer to the Highland Railway when a separate entity.

It is announced that Mr. Charles L. Mason, the carriage and wagon divisional superintendent at Newton Heath, London, Midland and Scottish Railway, has been appointed to succeed the late Mr. F. E. Gobey as carriage and wagon divisional superintendent at Wolverton.

It is, at last, officially announced that the electrification of the lines between Manchester (Victoria) through Oldham to Shaw, together with the Royton branch, is at once to be proceeded with. The expenditure will be about £600,000 and the work will take twelve months to complete.

The North of Spain Railway is electrifying the Pájares ascent on its line, over which Asturian coal has to pass on its way to the centre of the peninsula. When the scheme is completed this section will be able to deal with three times the present traffic and time will be gained in transport.

It is hoped to complete the electrification of the Brighton section of the Southern Railway to Coulsdon and to Sutton by February next. The first portion of the South-Eastern electrification will be from Victoria to Orpington, and it is hoped to finish that by July 1st and to have the whole completed by 1926.

Seven electric locomotives of a new type have been ordered by the New York, New Haven and Hartford Railroad from the General Electric Company. Each will be a "travelling sub-station" capable of picking up alternating current at 11,000 volts from the overhead wires and changing it to the direct current which will be used to operate the driving motors.

Cinematograph lectures are to be included in the educational scheme arranged for its staff by the London, Midland and Scottish Railway, and it is proposed in this way to illustrate various aspects of railway work. From the films, for instance, it will be possible for a man to follow the construction of a wagon from the rough timber and steel, or to study the intricacies of a locomotive.

The remainder of the reconstructed City and South London Railway, *i.e.*, the portion between Moorgate-street and Clapham Common, is to be reopened on December 1st. As in the case of the stations on the northern portion —reopened on April 20th last—the platforms have been lengthened. The reconstruction has consisted in enlarging the diameter of the tubes so as to take standard size rolling stock.

Speaking at a luncheon after a run with some new Pullman cars on Thursday of last week, Brigadier-General Baring, the new chairman of the Southern Railway, said that the company hoped to put into service on July 1st next a new cross-Channel steamer which would give more seats for passengers, more deck space and better shelter from the wind and weather. It was being built by Denny's, of Dumbarton, at a cost of £190,000.

Engine No. 4082, Windsor Castle, on the Great Western Railway, has, says the *Great Western Railway Magazine*, received a commemoration plate intimating that on April 28th, 1924, it was driven from the works to the railway station at Swindon by King George V., accompanied by Queen Mary. Engine No. 4073, Caerphilly Castle, was removed from the British Empire Exhibition on the 6th instant and was at work again on the 7th.

It is stated that the Southern Railway Company has prepared plans for the construction at Ventnor of a funicular railway. Parliamentary powers will be sought next session, and if the estimated cost is satisfactory work will be started at once. The railway will connect the varying levels of the town, beginning on the esplanade and finishing at the upper railway station. It is part of a scheme for the development of the Isle of Wight by the Southern Railway Company.

The result of a recent test of electrical apparatus, which took place on the South African Railways between Ladysmith and Chieveley, proved, according to the *South African Mining and Engineering Journal*, entirely successful, and both the locomotives and the overhead gear did all that was required of them. The recent test is to be followed by others of a more arduous and searching nature. From observations made it seems clear in official circles that the electrification scheme will prove an entire success.

Having regard to the fact that for several years past we have been advocating the operation of facing points by low-voltage electrical mechanism, so as to obtain the concession of the Ministry of Transport that power-operated facing points may be more than 350 yards from the box, it is a satisfaction to know that in addition to the three stations mentioned in our issue of January 18th last as having been so provided on the Great Western, four sets have recently been fixed by the same company at Pressgweene and one at Llanbradach.

The meeting at Eastbourne on the 12th instant between representatives of the corporation and Mr. E. C. Cox, the chief operating superintendent of the Southern Railway, would appear to have given satisfaction to the complainants. An effort is to be made to accelerate the arrival of a certain morning business train from Eastbourne. It was explained that the unpunctuality of the service was principally due to no new engines having been built during the war and up to the time of the grouping, and the summer traffic had proved too much for the existing stock of engines. The shortage of carriages was, in some degree, due to similar reasons and to a large number of vehicles being under reconstruction in view of electrification.

Notes and Memoranda.

It appears from the official report on the explosion of an oil still at Hull that the accident was caused by refilling the still with a mixture of oil and water at a time when it was hot from the previous distilling operation. The water was rapidly converted into steam, and the bottom of the still ruptured at a part where it had wasted away.

Three Rivers (Quebec) will have, says *Canada*, in October, 1925, the greatest paper mill in the world. The International Paper Company will by then have added three new machines to three existing mills, and their output will be more than 600 tons per day. The enlargement of the plant will involve an expense of nearly 5,000,000 dollars.

The largest dry dock of its kind in the world is now being constructed in Calcutta. The dock is being built in sections, and up to the end of July, 1923, 24 million cubic feet had been excavated. The first section will involve a total excavation of 40 million cubic feet. Work on the wet portion of the dock has already resulted in digging 31 million cubic feet.

An investigation has been made by the American Bureau of Mines on the explosion hazards incidental to unwatering coal mines, and although the cases cited are not sufficient to justify the hard-and-fast statement that there is always an accumulation of gas whenever water backs up under a head into mine workings. However, there is sufficient justification for issuing a warning that extreme care should be exercised when entering an area from which any considerable amount of water has been drained, and especially so if that water has been standing under a high head.

In the course of a paper on "Girders in Ships," read before the North-East Coast Institution of Engineers and Shipbuilders, Mr. J. Foster King said that he thought there should be a desire on the part of the shipbuilders to know more about the foundation of their work—the real strength of the steel which they used so confidently. Steel makers might know, but they did not tell users, which function of steel provided a correct measure of the greatest working stress that might be applied to flexible structures without undue fear of breakdown during their natural lifetime.

In the course of a lecture delivered at a meeting of the Cleveland Institution of Engineers, held at Middlesbrough on November 10th, Major H. G. Scott, blast-furnace manager for Bolckow, Vaughan and Co., protested against the severe criticism to which Cleveland blast-furnace practice has been subjected. The local ironstone was, he said, one of the poorest, if not the poorest, in the country, and the necessarily slow process of removing the impurities limited the output. There was not so much room for improvement as outsiders thought, and, in his opinion, the various works in the North-East Coast district were never better equipped than at the present time.

The platinum deposits in the Waterberg district of the Transvaal are said to be almost unique in being of lode formation, whereas 99 per cent. of the world's production of that metal is obtained from alluvial placer deposits. The main platinum lode occupies a fault in the felsite of post-Karroo age, striking in a north-east to south-west direction, which brings Bushveld sandstone on the south side down against the felsite. It is traceable continuously for 2½ miles, and sends off a branch lode, nearly ¼ mile long, from which the highest values in platinum have been obtained. It is on these two lodes that the principal work has so far been done, although farther west as many as six parallel lodes have been located.

The behaviour of air under high-voltage stresses and other factors in high-voltage transmission were discussed at the Pacific Coast Convention of the American Institute of Electrical Engineers, in Pasadena. The engineers of the pioneer 220-kv. lines presented new data, and the specialists in corona added other papers in an endeavour to determine quantitative laws for insuring greater efficiency and reliability. The thanks of the electrical industry are due to these men for the remarkable success made with existing 220-kv. lines; but, as was to be expected, several minor problems remain to be solved before complete success is obtained. These problems are connected with insulation, corona, control and conductors, and the data and papers presented at the Convention indicate their early solution.

A steam-jacketted pan used in concentrating milk in a dairy recently exploded, with fatal results to one man, and the Engineer Surveyor-in-Chief to the Board of Trade takes the opportunity to remark that although the defect which led to the explosion was not visible unless the inner and outer dished parts were taken apart, as they were secured together by bolts, a complete inspection inside and out could without difficulty have been made. If such inspection had been carefully made annually, the defect might have been observed, and the explosion and loss of life prevented. There is also another important point referred to in the report, viz., that the safety valve weight could easily be moved along the lever to load the valve to double the maximum working load. This was also wrong, and on the whole there seems to have been considerable laxity, from the safety point of view, in the manner in which the vessel was worked.

Detecting the presence of distant storms in order to have generators ready for instant load demands does not, states a writer in the *Electrical World*, require so much expensive equipment as some operating engineers might suppose. The apparatus installed in the remote control room of the West End generating plant of the Union Gas and Electric Company is very simple. The equipment consists of a panel on which is mounted an ordinary door-bell connected with a dry-cell battery, a Marconi coherer, two sensitive electro-magnets, an electric lamp and a combination push-button switch and socket for an attachment plug. Leading from the panel are aerial and earth wires. The aerial wire is a single strand antenna stretching 100ft. overhead from the chimney to a corner of the roof of the building. When the bell starts ringing and the light flashes, it is an indication that a storm is in the distance. Since the storms take from one hour to two hours to reach Cincinnati, sufficient time is allowed the operators to prepare for increased load demands occasioned by darkness.

Miscellanea.

The authorities of Yunnan, China, propose to raise about £300,000 annually, either in cash or forced labour, for the purpose of building motor roads.

It is proposed to improve the harbour at Los Angeles at a cost of 21,200,000 dollars. The depth of the channel is to be increased to 35ft. at low water.

An undeveloped deposit of exceptionally high-grade gypsum, most favourably situated for development and shipment, is reported on Shubenacadie River, Nova Scotia. It is said to have a measurable tonnage of 200,000 tons, with probably several further million tons of commercial gypsum.

Underlying the composite coal and torbanite seam on the Transvaal Coal and Oil Shale Corporation's properties there is a main coal seam 4ft. 9in. in thickness. This coal is said to have a calorific value of 12,500 B.Th.U. and 31 to 36 per cent. volatile, yielding about 30 gallons of oil and tar per ton.

The Rhodesian Government is making an extra grant to the Rhodesian Museum at Bulawayo in order to permit of the engagement of a geologist for the next three years, to be stationed in Bulawayo. In Bulawayo it is considered that this appointment will undoubtedly be of very great assistance to the small worker and prospector.

It appears that the Spanish Directorate is inclined to attempt the solution of the coal problem by grouping the mines, especially in the Asturias, believing that by reducing the number of companies sufficient economies in general expenses will be effected to allow of competition with British coal. About 60 per cent. of Asturian coal is produced by five companies and 10 per cent. by five others.

Rapid progress toward the initial operation of the new Weymouth generating station of the Edison Electric Illuminating Company of Boston is now being made, and it is anticipated that the installation will be delivering commercial energy to the system before December 1st. The high-pressure boiler, piping and turbine equipment is likely to go into service in the latter part of the winter.

An Engineering Exhibition is to be held in the Drill Hall, Dumfries-place, Cardiff, from Thursday, November 27th, to Saturday, December 6th next. It is being held under the auspices of the South Wales Institute of Engineers, of which Mr. W. A. Chamen, M.I.E.E., is president for the current session. From the catalogue, a copy of which lies before us, it appears that between seventy and eighty firms, from all over the country, are participating in the show, and evidently there will be a representative display of engineering and mining machines and apparatus.

A law was passed in France in August, 1923, placing at the disposal of the Office National du Credit Agricole a sum of 600,000,000f., to be distributed in the form of long-term loans to be granted at reduced rates of interest to communities for rural electrification. At the recent Rural Electrification Congress, held at Lyons, it was stated that the law in question was a snare, since the subsidies proposed were only possible if the necessary credits were incorporated in the Budget Estimates. But no such credits were provided for, and the State finances were unfavourable.

The world's largest passenger flying boat starts a regular service this week on the Southampton-Channel Islands route. A Napier Supermarine Swan, it is driven by two 450 horse-power Napier Lion engines, and carries twelve passengers. It is also the fastest passenger boat in the world, and it can cruise comfortably at 100 miles per hour. In a recent test the Swan rode comfortably at her moorings and rose on a sea which drove all other flying boats to shelter. The machine will make the Southampton–Guernsey trip in one hour, instead of one and a-half hours, which the present machines take. She will be able to fly in any weather short of a gale.

It is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in October amounted to 586,400 tons, compared with 569,200 tons in September and 595,700 tons in October, 1923. The number of furnaces in blast at the end of the month was 171, an increase of 1 since the beginning of the month, 7 furnaces having been blown in and 6 damped down or blown out. The production includes 192,900 tons of hematite, 185,300 tons of basic, 157,700 tons of foundry, and 28,500 tons of forge pig iron. The output of steel ingots and castings amounted to 678,500 tons, compared with 645,000 tons in September and 702,200 tons in October, 1923.

The conclusions arrived at by Mr. Campbell M. Hunter in a paper read on "Oilfields of Argentina" at the Royal Society of Arts are that the prospects of developing an important oil industry in Argentina are more than promising. Hitherto attention has been chiefly directed to the southern coastal fields, namely, those at Comodoro Rivadavia, where, within the brief space of seventeen years, an annual production at the rate of about 750,000 tons has been built up. Now, however, increasing regard is being paid to the other and higher grade oilfields of the country, notably those in the district of Neuquen. There, as in other parts of the Republic, numerous favourable geological structures are found, which, in the author's opinion, are destined to play an increasingly important part in the economic future of the country.

Some time next year the great Mulungushi Falls hydro-electric scheme will be placed in commission and will generate power for the Rhodesia Broken Hill Development Company. The turbine will be of the Pelton type, and have a capacity of 3150 horse-power, running at 750 revolutions per minute. It is to be connected to a 2000-kilowatt, three-phase, 2000 volts generator. The current will be stepped up to 44,000 volts for transmission to the mine, where it will be reduced to the original voltage. It is intended at first to produce power only to the extent of 2500 horse-power, but the permanent works will enable extensions to be made to the generating plant which will allow for an output up to 10,000 horse-power. It is estimated that there will be a saving of about £15,000 by hydro-generation over the steam-driven plant. The cost of the scheme is estimated at £150,000.

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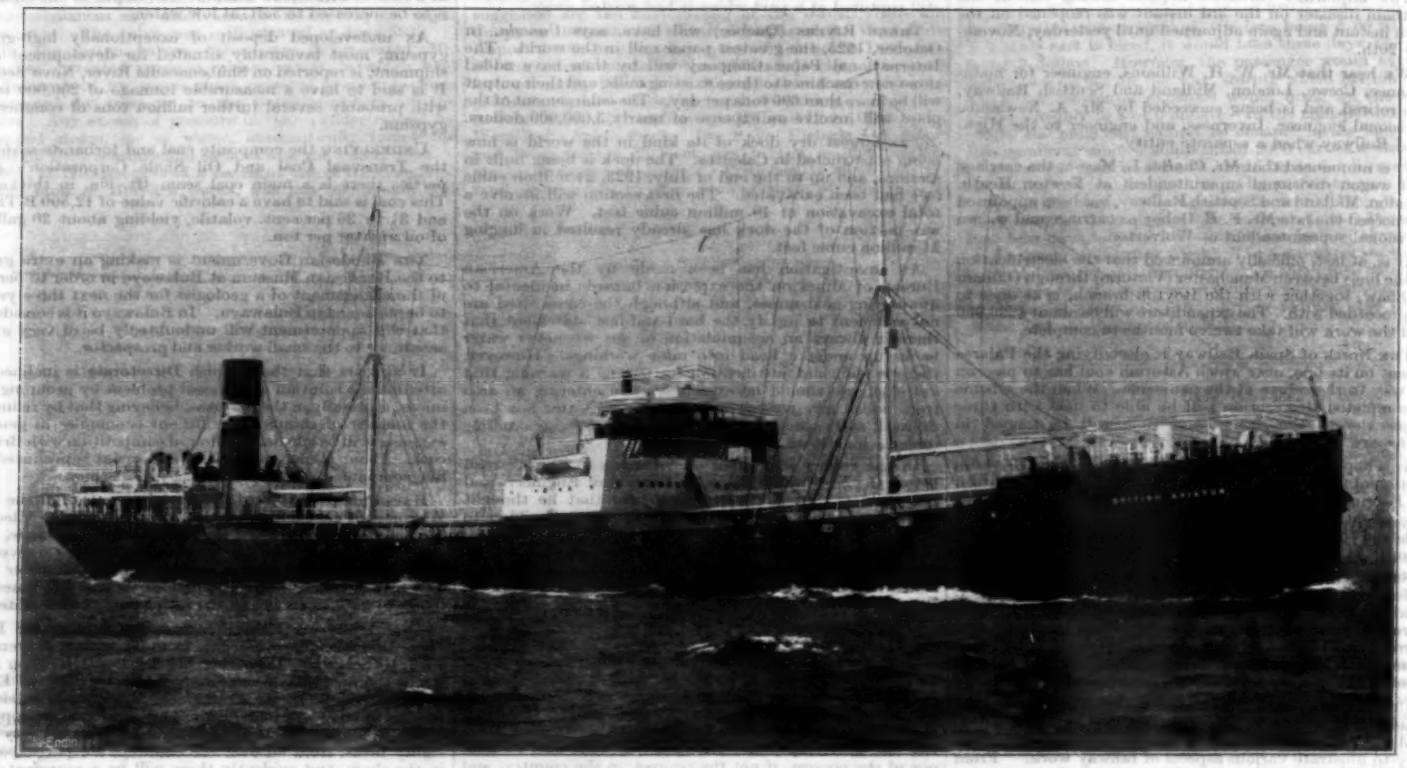

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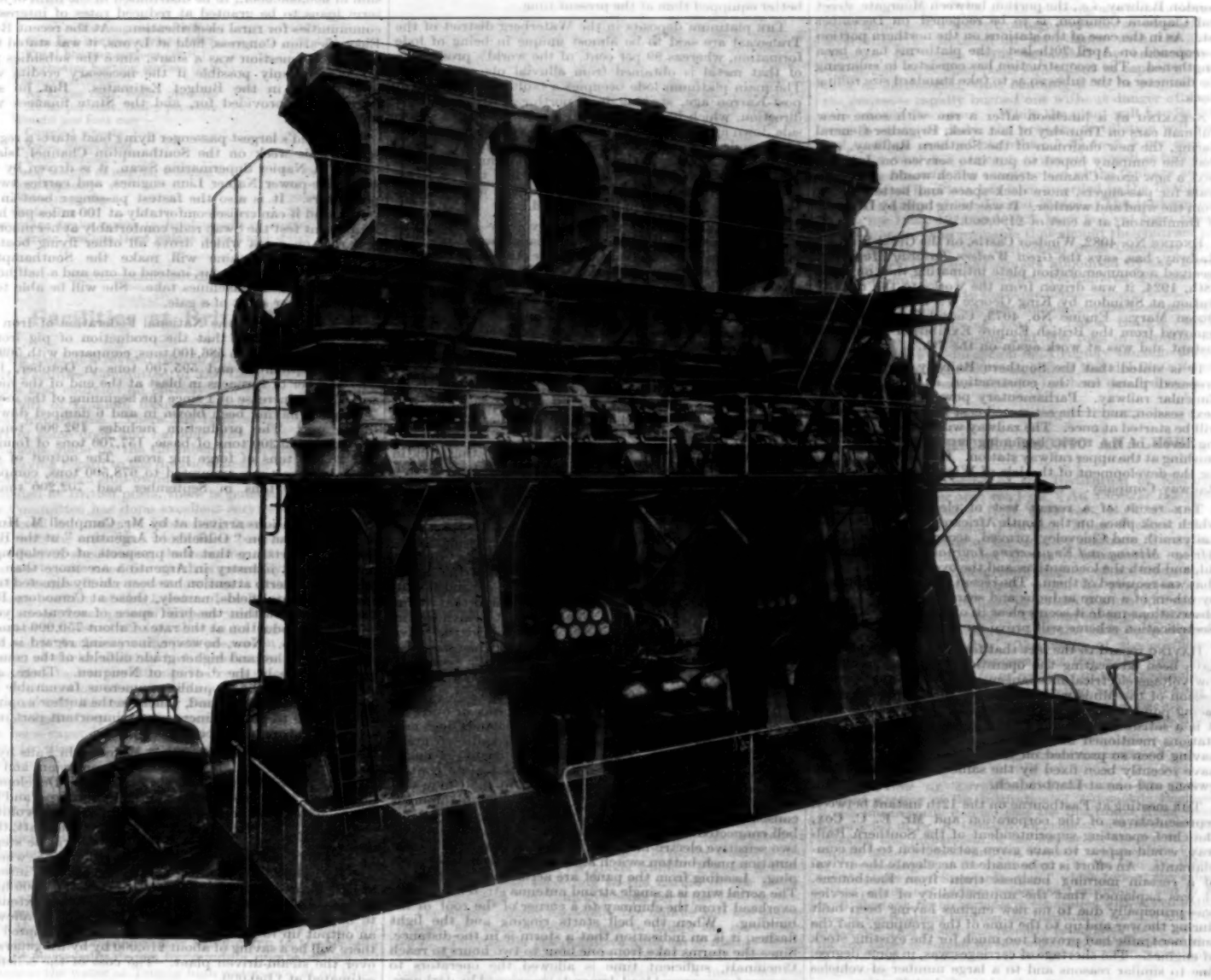

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DEATH.

On November 13th, at his residence, 8, Riverdale-road, Sheffield, following a short illness due to pneumonia, William McLean, chairman of William McLean, Limited, of Sheffield, aged 49 years.

THE ENGINEER.

NOVEMBER 21, 1924.

Cast Iron.

In these days of alloy steels, and of special and often expensive materials of all kinds, cast iron is perhaps regarded with something akin to contemptuous indifference—it is, in fact, something of a metallurgical Cinderella. While it is, of course, undeniably the crudest and cheapest form of iron, its very cheapness gives it an added importance and should secure for it careful consideration, both from the designer, who may find it possible to use it in place of more costly metal, and from the metallurgist, who may be able to render it more suitable for extended uses. Unfortunately, the foundry industry is one not favourably situated for the development of new ideas. The very simplicity of its plant and processes favours the growth of numerous small establishments, which have neither the resources nor the initiative to effect advances, since they are fully occupied in making the best commercial success out of "things as they are." In other cases the ironfoundry is frequently an adjunct to a large engineering works, and there, also, is apt to receive less than its proper share of interest and attention. So long as the castings come up to the average standard expected by the engineers, the only thought given to foundry matters is that of production costs.

This state of affairs is, however, decidedly unfortunate at a time when progress in regard to cast iron is being made abroad, and when, as perhaps never before, our industries are faced with difficulties arising from intensive competition, coupled with adverse circumstances. The kind of progress to which we refer has been made in several directions, the two most important being perhaps in regard to centrifugal casting and permanent moulds. The fact that the centrifugal casting process with all its remarkable possibilities is by no means being neglected in this country does not detract from our argument; British industry in all its branches is generally ready enough to take up new processes, once their value has been commercially demonstrated elsewhere. There is, of course, much plausibility in the argument that it is wise to let others "try out" a new process and develop it to the point of commercial success, leaving our industry to come in at the later stage to reap a large share of the resulting profit. Unfortunately, such a plan has not proved particularly successful in the past, although it has been widely tried. Somehow, the process of reaping the profit does not seem to work as well as might be desired. Perhaps it is the attitude of mind engendered by the adoption of this type of "wait and see" policy that insidiously militates against success of the highest order—or perhaps the man, or the nation, first in the field with a new product or process has a way of securing the market before those who only take the thing up after its value has been proved can get effectively to work. At all events, for British industry as a whole, the cautious waiting policy which asks of any new proposal "where has it been done before?" has not resulted in that condition of general advancement which is to be desired. In regard to the second process we have mentioned—the production of iron castings in so-called permanent moulds, *i.e.*, in moulds made of metal—the "wait and see" stage appears as yet not to have been passed. Yet remarkable success has already been attained in America, and it is at least possible that we have here a radical advance in the production of castings. Our point, however, is not so much that British foundrymen should take note of these actual things and perhaps adopt them, as that they themselves have not of late been fruitful in similar advances—that the industry here is not sufficiently actively progressive to keep itself in the forefront of the world's progress in regard to a material whose real importance is perhaps seriously underrated.

That some at least of the British ironfounders have realised the need of a more progressive policy is proved by the formation, about three years ago, of a British Cast Iron Research Association, but unhappily that Association has not so far received anything like the support which it deserves and needs, either from ironfounders or from engineers and other large users of cast iron. This indifference is, perhaps, to be accounted for by the state of the industry and its lack of large organisations. In such a state, however, there is the strongest need for co-operative effort. The reputation of an industry, both at home and abroad, is to a considerable extent at the mercy of the smaller and weaker firms engaged in it—their product, too, is "British cast iron" and improvement must reach them also. There are, fortunately, indications that recent changes in this organisation have infused a new spirit into the whole of its activities, and we sincerely hope that it will now proceed vigorously with its proper work—the conduct of research that will lead to real progress in the cast iron industry. There are few industries where progress is more urgently needed, not only from the point of view of the ironfounder himself but also from that of the engineer who, in the interests of economy, desires to utilise as fully as possible the cheapest material at his disposal. If the present efforts of the Research Association and of those who direct its work, are adequately supported by those who, in one way or another, have to rely upon cast iron, rapid progress should be possible. So far as the engineer is concerned, if he can obtain better castings—of more uniform quality, with fewer gas cavities or shrinkage holes, with the graphite so disposed as to produce less weakening, and with freedom from chill or hard spots that interfere with machining—he will rapidly reap advantages far outweighing the cost of experiment and research, even on an extensive scale.

Temperature Control.

In nearly every industrial or technical process in which the materials of engineering are concerned, the application of heat plays an important part, and as our knowledge of the true nature of these operations and processes advances we discover, increasingly, the importance of an accurate and continual control of the temperatures involved. Whether we think of the stoving of an enamel, the forging or rolling of structural steel or the hardening of tools, success depends upon the use of the proper temperature for each step of the process. To some extent, of course, this fact has been recognised by practical men for a long time, since a very little experience is sufficient to show that gross errors of temperature lead to obvious failure—the enamel will go dull, blister or burn, the steel will break up in the forge or prove weak and brittle when finished, or the tool will crack or be too soft. Fortunately for the earlier development of industries of this kind, men soon attained a certain skill in judging temperatures which enabled the more expert to avoid the grosser kinds of error and thus to diminish the percentage of obvious failures. Out of this degree of success an industrial practice has grown up which for many years has held sway in many of our technical industries, relying upon the personal judgment of

the skilled workman to insure successful production. Up to a certain point this reliance was and may still be justified. So long as processes were fairly simple, material not of very varied kinds, and the demands made upon those materials not too stringent, the rule-of-thumb methods of the skilled man proved commercially satisfactory.

At the present time, however, conditions in all these respects have undergone fundamental change. Not only are materials widely varied in quality and in the treatment they require, but the accuracy of that treatment must also come up to a much higher standard because the demands made upon the product, both by specification tests and by service needs, are much more stringent than they were even twenty years ago. Nor can we take the view that these requirements are too stringent, or the materials too varied, since other competing countries are ready and anxious to supply all such materials and to meet the most stringent requirements, and it is the pressure of this competition which makes further reliance on skilled judgment where scientific measurement is possible a commercially untenable proposition. Take, for instance, so relatively simple a matter as the hardening and tempering of leaf springs such as are used for motor cars or lorries. It is true that there are considerable diversities of opinion not only as to the particular quality of steel that should be used for that particular purpose, but even as to the precise degree of temper or hardness which should be provided in any given steel. None the less, anyone producing such springs must work to some definite idea as to the proper degree of hardness which they should possess, and, having once made up his mind on the point, his only logical course is to secure means for uniformly producing his springs with that particular temper. In fact, it is only if he does so that he can hope to ascertain for himself, by the test of actual experience in service, whether he is aiming at a correct or incorrect temper for his steel. If his product is variable its behaviour in service will give little satisfaction to those who purchase it and no information to the manufacturer as to how far his treatment is right or wrong. In such a case it would seem a simple conclusion that accurate means should be employed systematically to control and record the temperatures used, and in some of the most advanced shops in this country, and almost universally in America, this is done, with eminently satisfactory results. This fact goes to show that the difficulties of temperature measurement and control sometimes put forward are imaginary or at least very much exaggerated. It is, in fact, perfectly possible to register and control, automatically if desired, the temperatures of steel-hardening and tempering furnaces, whether on a large or a small scale. None the less, there are many shops in this country where there are either no pyrometers or where, if such appliances are installed, they are either disused or only used in a perfunctory and unsatisfactory manner. It is even seriously claimed that the skilled man can do the work as well as or better than it can be done with the aid of the pyrometer. This claim has been put to the test and disproved not once but many times, but it is made afresh from time to time even in one and the same industry. Neither such tests, nor the marked advances made by competing firms who avail themselves of scientific aids to temperature control, however, appear to affect the practice of the backward rule-of-thumb shops, and it is perhaps only the logic of commercial events which will ultimately crowd these out-of-date firms out of existence. Such a course of events, however, would be deplorable since in many other respects such shops often do excellent work, thanks to a long standing tradition which it would be a pity to lose.

The case which we have cited, of hardening springs, is typical but by no means extreme; we have seen the sad results of attempts to harden steel compass needles or stainless steel cutlery without the aid of pyrometers, and we have seen equally unhappy consequences from lack of temperature control in much heavier work. Certain parts of heavy steel boiler-plates for high-pressure boilers have to be bent and flanged in the press and are heated for that purpose. For such an operation the use of a correct temperature is very important, since the attempt to carry out the work at slightly too low a heat easily results in cracking the steel, either at once, or—worse still—when it comes under stress in the testing of the finished boiler. In view of existing metallurgical knowledge, one would have thought that due attention to such a point would be regarded as an obvious and necessary precaution in any boiler shop. Actually this kind of work is sometimes carried out by means of appliances so primitive as scarcely to deserve the term "furnace"—recalling, indeed, the metallurgical efforts of primitive man. In such conditions the matter is not merely a question of pyrometers, since they are useless unless something like a uniform temperature can be maintained, but it is eminently a case where there is urgent need for temperature control. Such cases, unfortunately, can be multiplied throughout a wide range of engineering industries and suggest the need of education. Twenty years ago, pyrometers were in a primitive stage and gave rise to endless trouble and even to error; the prejudices engendered in the minds of practical men by these early failures no doubt linger more or less as works traditions. To-day, as the widespread use of such appliances, particularly in America, indicates such difficulties have been in large measure overcome, so that there remains little or no excuse for lack of knowledge or control of industrial temperatures.

Literature.

Elasticity and Strength of Materials used in Engineering Structures. Section IV.: Columns. By C. A. P. Turner, M. Am. Soc. M.E., M. Am. Soc. C.E., Member of the American Society for Testing Materials. 1924. Minneapolis, Minn. Price 5 dollars.

The author of this well-written book keeps closely to the point throughout, and has been able in 134 pages to deal adequately and vigorously with theory and data, and with the more important of the considerations affecting design. Mr. Turner, who is a consulting engineer, has a good sense of values; he explains the reasons for various modifications which have been made in formulas; points out what elements of design and what items in the behaviour of stressed columns have, during the evolution of formulas, been overlooked; states clearly his own conclusions; and compares values derived from tests with the corresponding values obtained from several different formulas. He believes in the strait and narrow path of correct theory. Lack of precise knowledge, with examples, is deplored, and "a rational theory to bridge this void" is developed.

Following the general reasoning of Tredgold and Rankine, a formula is derived which is applicable to columns of moderate length, and should be combined with Euler's formula in the case of long columns. A chapter on the economic theory of steel column design, including consideration of "twist," is accompanied by tables of the results of tests, giving also the values obtained from various formulas. Referring to the design of the Forth Bridge, Mr. Turner remarks that the ultimate strength of the main vertical posts was very conservatively estimated, but that the value "seems on a par with the strength developed in nickel steel columns of American design, lacking the satisfactory disposition of metal adopted by Messrs. Fowler and Baker." A useful chapter on the physical properties of steel concludes with a condemnation of ill-conceived building codes (by-laws), bad economy and danger resulting from the failure to allow an increase in working stress for improved strength, toughness and durability of the materials of reinforced concrete.

A short but very interesting chapter on tests of large bridge columns is accompanied by tables of results, and includes a comparison of the Forth and Quebec designs; the section of the former having "ample radius of gyration and excellent distribution of metal from the standpoint of symmetry," while tests of models of corresponding members of the latter "disclose an ultimate strength . . . ranging from 15 to nearly 30 per cent. below the yield point unit stress of the plates and angles which make up the section." Owing to the amount of work involved in making members of circular section, the author prefers his own octagonal design, and is bold enough to claim that it has "all of the advantages" of the Forth section. In the chapter on reinforced concrete columns, the value of spiral and hooped reinforcement is specially stressed, and other matters are suitably dealt with. The author's treatment of his important subject is both skilful and reasonable, and his matter is well arranged.

Modern Farm Machinery. By D. N. McHardy. London: Methuen and Co. 7s. 6d. net.

The object of this book, as set out in the preface, is to explain in simple language the principles of construction, the uses and the operation of modern machines which are employed in the agricultural industry. At first sight this might appear an easy task, but when the complete range of implements which are now employed in this industry is analysed, it will be seen that the subject is a fairly extensive one. The author's task is rendered more difficult inasmuch as his readers are likely to be possessed of comparatively little technical knowledge of engineering. The writer of such books must therefore have extensive practical experience as well as theoretical training. Engineers may provide the appliances which will assist the farmer, but unless they are used intelligently and are treated with a certain amount of care such appliances are likely to prove encumbrances rather than aids to successful farming. It is therefore necessary on farms employing up-to-date products from the agricultural engineering works to keep a man about the farm whose time will be chiefly occupied in overhauling and maintaining the machinery in a proper working condition.

This book contains twenty chapters dealing with farm implements such as the plough, drainage machinery, cultivators, seeding machinery, manure distributors, mowers, harvesting machinery, stationary motors, barn implements, threshing and elevating machines, all of which are illustrated. The chapter on motors might be extended considerably with advantage. The author has confined himself to the description of very few oil engines, with the theory of the two and four-cycle types, but appears to have considered the steam engine unworthy of notice. The subject of farm transport, too, is very inadequately dealt with. Most of the illustrations of machinery are made from catalogue blocks and some of the sketches are very crudely drawn. If a further edition of the book is called for these defects will no doubt be remedied to a large extent. Even as it stands, however, farmers will be able to obtain from this publication a considerable amount of information regarding the details of construction of farm machinery which they have not hitherto had an opportunity of acquiring.

A Hundred Years of Portland Cement, 1824–1924. By A. C. Davis, M. Inst. C.E. London: Concrete Publications, Limited, 4, Catherine-street, Aldwych, W.C. 2. Price 21s.

This book is intended to celebrate the centenary of the invention of Portland cement, and it has been prepared by one who is eminently suited for the task, both by reason of his practical knowledge of cement manufacture and of the amount of research which he has devoted to the history of the subject. The result is an exceedingly interesting volume, which will appeal equally to those who are directly interested in Portland cement and its use and to those to whom historical research of any kind has an attraction of its own.

Mr. Davis is among those who, while they admit that Joseph Apsdin, the bricklayer of Leeds, undoubtedly coined the name "Portland cement," do not consider that the material made in accordance with the patent specification of his invention, which was dated December 15th, 1824, was Portland cement as we know it to-day. The book is divided into a preface, eleven chapters and an appendix. Chapter I. is entitled "Early Investigators," and Chapter II. "Early Experiments Leading up to Manufacture." In them are discussed the work and experiments of Smeaton, Higgins, Parker, Dobbs, Vicat, Treussert, St. Leger, Frost, Pasley, Joseph Apsdin, and I. C. Johnson. The particular contribution of each to the general knowledge of the subject is clearly reviewed, and much light is thrown on the question by quotations from contemporary documents.

The four succeeding chapters are concerned with the progress of the industry during the periods 1824–49, 1849–74, 1878, and 1874–99. Then comes a chapter on the "Rotary Kiln," which is followed by chapters devoted to "Standard Specifications," "Comparison of Portland Cement Specifications of Various Countries," and "Research in the Cement Industry," and the final chapter is entitled "Portland Cement in the Twentieth Century." The appendix contains copies of some early patent specifications for cement and machinery used in its manufacture.

BOOKS RECEIVED.

Swedish Ports. The Swedish Consulate-General in London, 329, High Holborn, W.C. 1.

Annual Report of the Reclamation Service, 1922–23. Ottawa: Department of the Interior, Canada.

Fluxes and Slags in Metal Melting and Working. The Faraday Society, 90, Great Russell-street, W.C. 8. Price 7s. 6d. net.

Bulletin of the Imperial Institute, Vol. XXII. No. 3. London: John Murray, Albemarle-street, W. Price 3s. 6d. net, by post 3s. 10d.

Mathematics for Technical Students. By E. R. Verity. London: Longmans, Green and Co., 30, Paternoster-row, E.C. 4. Price 12s. 6d. net.

Motor Car and Coach Painting. By Charles E. Oliver. London: W. R. Howell and Co., 42, Theobald's-road, W.C. 1. Price 28s. 6d. net.

Indian Railways. By K. V. Iyer. London: Humphrey Milford, Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 3s. net.

Diesel Engine Design. Second Edition. By H. F. P. Purday. London: Constable and Co., Limited, 10–12 Orange-street, W.C. 2. Price 21s. net.

Sixty-three Years of Engineering, Scientific and Social Work. By Sir Francis Fox. London: John Murray, Albemarle-street, W. 1. Price 18s. net.

Eddruck auf Stutzmauern. By R. Petersen. Berlin: Julius Springer, Linkstr. 23–24, Berlin, W. 9. Price 5.40 goldmark; bound 6.30 goldmark.

The "Magnus" Effect.

A CONSIDERABLE amount of scientific as well as popular interest has been aroused concerning the so-called Magnus effect, alleged to be employed by Herr Anton Flettner for the propulsion of his wind-power ship Buckau. In a Journal paragraph in last week's issue we briefly indicated the nature of this effect. We now propose to set it forth a little more fully.

Heinrich Gustav Magnus (1802–1870) was a German chemist and physicist, who, after studying under Berzelius, Gay-Lussac, Thénard, and others, settled in Berlin and eventually become Professor of Technology and Physics at the University of that city. He studied and wrote papers on many chemical and physical subjects, such as the spontaneous inflammability of finely divided iron, nickel and cobalt, the expansion of gases by heat, the polarisation of heat, thermo-electricity, electrolysis, and the thermal effects produced by the condensation of moisture on solid surfaces. Incidentally, he appears to have studied the velocity of bullets and the effect of wind on their flight, and, in general, the effect of wind on any rapidly rotating body. In the latter connection, he discovered the phenomenon with which his name is to-day being prominently associated.

Without entering too fully into the modern theories of air flow round cylindrical and other bodies, it is possible to obtain a picture of the Magnus effect by considering the superposition of a vortex motion on the stream-line flow of a fluid past a cylinder. In Fig. 1 the steady stream-line flow of an inviscid fluid past such a body is represented. It is symmetrical about two axes at right angles to each other, so that if we take four points A B C D, Fig. 2, on the surface of the cylinder at opposite ends of two symmetrically disposed diameters, the velocities of the fluid past these points will all be equal. These velocities are indicated by the short arrows on the circumference of the circle in Fig. 2. They give rise to pressures p_a, &c., which, since the fluid is inviscid, are all equal and directed radially inwards towards the centre O. Since these pressures are equal and symmetrical, they produce no resultant force on the cylinder. Now, let it be supposed that a vortex or cyclic motion such as that represented separately in Fig. 3 be superimposed on the stream-line motion, the centre of the vortex being coincident with the centre of the cylinder section. This additional motion apart from the first gives rise to velocities at the points A B C D, Fig. 2, which are tangential to the surface and all equal. They are represented in Fig. 2 by the arrows drawn just outside the circle. It will be seen that the two velocities, so far as the points A and B are concerned, assist each other, but at the points C and D they are in opposition. The net result is that the velocities of the fluid past A and B are increased, while those past C and D are reduced, it may be, to zero or even to the extent of being reversed. The streamline flow is no longer symmetrical about the line P Q, but may be represented as shown in Fig. 4.

In any inviscid incompressible fluid the pressure and velocity at any point of a stream line are connected by the relationship—

$$p + \tfrac{1}{2}\rho V^2 = \text{constant}.$$

That is to say, as the velocity is increased the pressure falls off, and *vice versâ*. It follows therefore that under the combined motions the radial pressures at the points A B, Fig. 2, are less than the radial pressures at C D. Consequently, there is a resultant force on the cylinder in the direction from the lower to the upper side of Fig. 2; that is to say, at right angles to the first, or stream-line, flow of the fluid. It is obvious that the magnitude of this resultant force is dependent upon the extent to which the velocities on one side of the cylinder are increased, and to which those on the other are decreased; that is to say, the magnitude of the resultant is determined by the strength of the added vortex motion as well as by the velocity of the first motion.

Generalising the result arrived at, it may be said that if a cylinder is moved in a straight line through an inviscid fluid, upon which is impressed a vortex or cyclic motion, the centre of which is preserved constantly coincident with the centre of the cylinder, a force will act on the cylinder at right angles to the path. As the resultant force is at right angles to the path, it follows that the cylinder will experience no resistance in the direction of its path.

Such is an elementary discussion of the Magnus effect. Its application to the propulsion of ships, as in the Flettner scheme, obviously requires additions to and modifications of our simple discussion. We have to take account of the fact that the fluid to be dealt with is neither inviscid nor incompressible. Even though a suitable adjustment could be made in a ready manner, theoretical treatment would still be unsatisfactory, because of the imperfections of any practical means which can be adopted for creating the required cyclic or vortex motion. We may imagine the stream-line motion of Fig. 1 as representing the wind, but it is clear that the rotation of Herr Flettner's steel towers can give but an imperfect reproduction of the motion represented in Fig. 3.

It may be noted that the towers are about 10ft. in diameter, and can be rotated up to a speed of 120 revolutions per minute. Without making any allowance for their inefficiency as generators of cyclic motion, they would thus reduce to zero at one point on their circumference a wind blowing at some 40 odd miles an hour. The practical advantages of the system cannot be properly discussed in the absence of experimental data, but they would appear to rest on the result concerning which a statement is attributed to Herr Flettner, namely, that the propulsive force generated is from ten to fifteen times as great as could be obtained in the same wind from an equivalent area of ordinary sails. Considerable advantage is no doubt likely to accrue from the absence of rigging and from the fact that the resistance of the towers in the direction of the wind is as indicated by the theory zero, and in practice probably very small. It is clear, too, that by the use of two towers, the speeds of which can be separately varied, a new and powerful means of controlling the course of the vessel is made available. From the navigational point of view, the chief disadvantage would appear to lie in the difficulty of sailing the vessel in a following wind, for in such a case the propulsive force would be fully broadside on, so that no progress in the longitudinal direction would be possible, and tacking would have to be resorted to. This circumstance perhaps explains the inventor's selection of the regions of the trade winds as the most favourable for the exploitation of his idea.

We have taken Figs. 1, 3 and 4 from a pamphlet entitled "Applications of Modern Hydrodynamics to Aeronautics," by L. Prandtl, of Göttingen University, as translated and published by the United States National Advisory Committee for Aeronautics. Fig. 2 is taken from Professor L. Bairstow's well-known work, "Applied Aerodynamics."

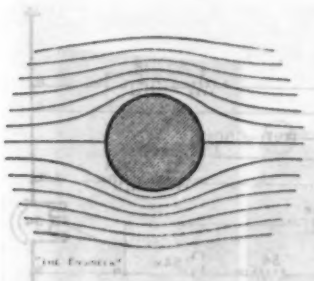


FIG. 1

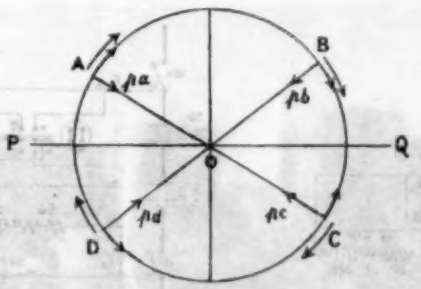


FIG. 2

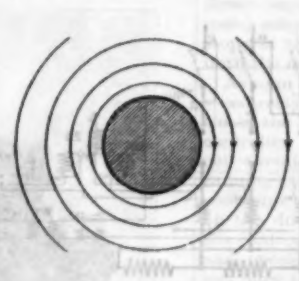


FIG. 3

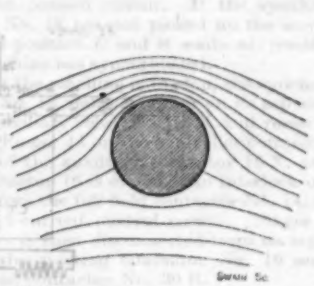


FIG. 4

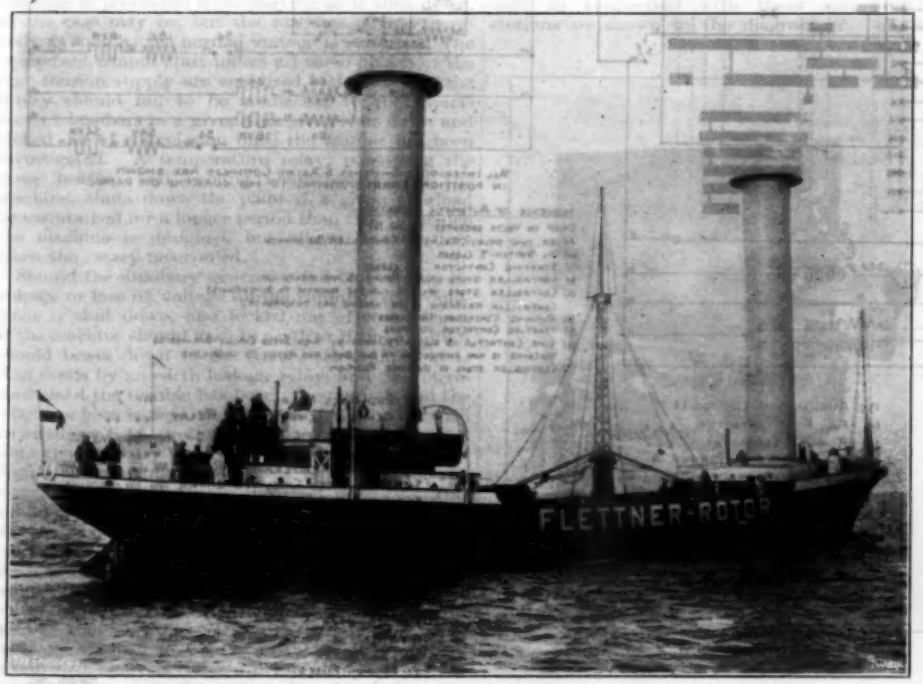


FIG. 5 THE FLETTNER WIND-POWER SHIP BUCKAU

SIXTY YEARS AGO.

ONLY so recently as sixty years ago the principal materials available for engineering construction were cast iron and wrought iron—steel could not then be described as a structural metal, but even then it is evident that the foundation was being laid for the heat-treatment which now plays such an important part in the adaptation of ferrous materials to more exacting conditions than their raw condition appears to merit. In an article by Zerah Colburn, in our issue of November 18th, 1864, he says that it has occasionally been attempted to give to cast iron greater absolute strength than can be obtained by merely mixing different brands, and he goes on to point out that there is no stage at which it is too early to begin to improve a given make of iron. At the same time Mr. Colburn pointed out that the cost of the treatment of iron, to improve its qualities, might be purchased at too great a price, and, except in such cases where weight was a serious consideration, might be prohibitive. Certainly the latter part of the article is confined rather to the practice of melting and re-melting cast iron, to its mixture with various alloys, and to the method of applying the blast during melting, but there is a distinct undercurrent throughout the whole to the effect that the heat treatment of the material might be equally important. In the same issue we gave particulars of the first telegraph cable which was laid from England to America in the following year, but was not, of course, the first laid under the Atlantic, as two previous unsuccessful attempts had been made to connect the two continents. It is noteworthy, in this connection, that the wire for the successful cable was manufactured by Mr. G. Bedson, one of the pioneer wire drawers referred to recently in THE ENGINEER as the originator of the continuous system of rolling wire rods. . . . In another place in the same issue a graphic account was given of the heroic efforts made to close a breach in the Thames Embankment before the tide rose and inundated the low-lying land behind. The breach was caused by the explosion of some 46½ tons of gunpowder in a magazine near Erith, and was about 130ft. wide. The embankment was blown away to a depth of 8ft. to 10ft. below the level of the marsh, but fortunately the tide was low at the time of the accident.

A 500-Kilowatt Automatic Sub-station.

FOLLOWING American practice, the electrical manufacturers in this country have for some time past been giving attention to the development of automatic sub-stations, and plants of this kind have been put into operation at Manchester, Liverpool, and on the Underground Railways of London. The sub-station shown in Fig. 2 was exhibited at the British Empire Exhibition by the British Thomson-Houston Company, of Rugby. It is designed for a direct-current output of 500 kilowatts at a pressure of 550 volts. special feature of the equipment is a master-driven motor controller, which determines the sequence of the switching operations.

Experience has shown that whilst the ordinary electrical interlocking arrangements are quite satisfactory on small automatic equipments, the use of a simple and rugged mechanical device, such as this controller, is a great advantage in the case of large equipments, as it enables substantial contacts with heavy contact pressures to be used. Moreover, it definitely fixes the sequence of the various operations. As soon as a demand for power arises, and the direct-current line voltage drops in consequence, a master starting element closes its contacts, and energises the master control contactor through a time delay relay, which prevents the equipment starting up as the result of momentary fluctuations in the direct-current voltage.

When the master control contactor closes—which can only occur when the controller is in the off position—it energises all the control circuits, and the motor-operated controller is set in motion. Its first action is to close the high-tension oil circuit breaker, thus energising the main transformer. As the controller continues to rotate, it closes the starting contactor, and at the same time connects an auxiliary field winding on the rotary converter to the auxiliary generator, which is belt-driven from the converter's main shaft. The closing of the starting contactor energises the starting motor, and at this point the controller stops and waits until the converter runs up to speed and synchronises. As the machine runs up the auxiliary generator builds up its voltage, thus energising the auxiliary field winding, and at the same time it energises a synchronous field contactor which completes the main field circuit of the rotary and adjusts the field to the correct strength for synchronising.

When the machine is in synchronism with the supply voltage, a synchronous speed-indicating relay re-starts the controller, which closes the running contactor, thus connecting the rotary direct to the transformer. Immediately afterwards the starting contactor opens and the auxiliary field winding is disconnected from the auxiliary generator, whilst the field strength of the rotary is adjusted to the correct value for parelleling by the closing of the full

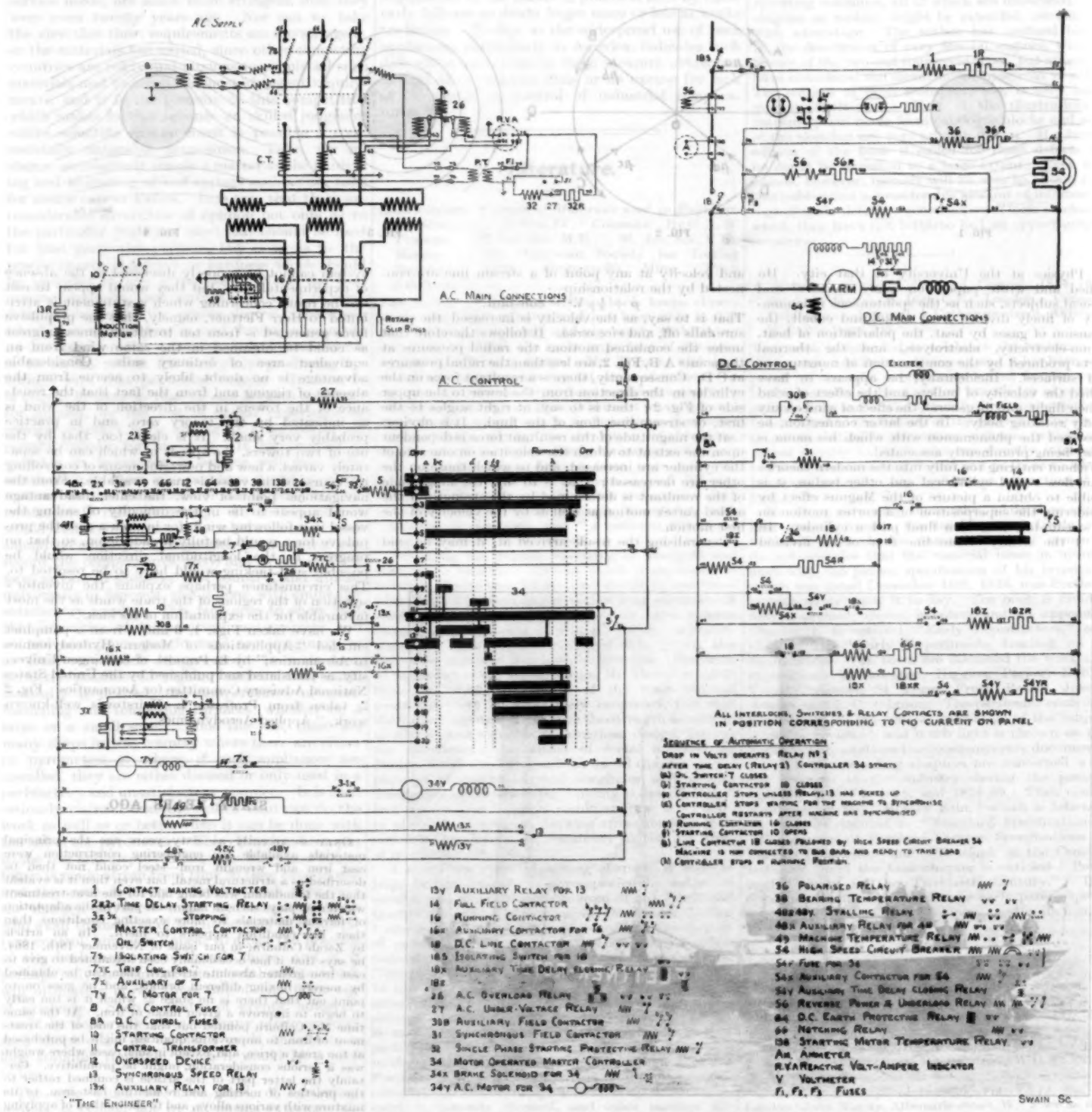

A.C. Supply
A.C. Main Connections
D.C. Main Connections
A.C. Control
D.C. Control
Exciter
Aux. Field
Arm
All Interlocks, Switches & Relay Contacts are shown in position corresponding to no current on panel
Sequence of Automatic Operation
Drop in Volts operates Relay No 1
After time delay (Relay 2) Controller 34 starts
(a) Oil Switch 7 closes
(b) Starting Contactor 18 closes
(c) Controller stops unless Relay 13 has picked up
(d) Controller stops waiting for the machine to synchronise
Controller restarts after machine has synchronised
(e) Running Contactor 16 closes
(f) Starting Contactor 18 opens
(g) Line Contactor 18 closes followed by High Speed Circuit Breaker 54
Machine is now connected to bus bars and ready to take load
(h) Controller stops in running Position.
1 Contact making Voltmeter
2&2x Time Delay Starting Relay
3&3x " " Stopping "
5 Master Control Contactor
7 Oil Switch
7s Isolating Switch for 7
7tc Trip Coil for "
7x Auxiliary of 7
7y A.C. Motor for 7
8 A.C. Control Fuse
8A D.C. Control Fuses
10 Starting Contactor
11 Control Transformer
12 Overspeed Device
13 Synchronous Speed Relay
13x Auxiliary Relay for 13
13v Auxiliary Relay for 13
14 Full Field Contactor
16 Running Contactor
16x Auxiliary Contactor for 16
18 D.C. Line Contactor
18s Isolating Switch for 18
18x Auxiliary Time Delay closing Relay
18z "
26 A.C. Overload Relay
27 A.C. Under-Voltage Relay
30B Auxiliary Field Contactor
31 Synchronous Field Contactor
32 Single Phase Starting Protective Relay
34 Motor Operated Master Controller
34x Brake Solenoid for 34
34y A.C. Motor for 34
36 Polarised Relay
38 Bearing Temperature Relay
48&48y Stalling Relay
48x Auxiliary Relay for 48
49 Machine Temperature Relay
54 High Speed Circuit Breaker
54y Fuse for 54
54x Auxiliary Contactor for 54
54y Auxiliary Time Delay closing Relay
56 Reverse Power & Underload Relay
64 D.C. Earth Protective Relay
66 Notching Relay
138 Starting Motor Temperature Relay
Am. Ammeter
R.V.A Reactive Volt-Ampere Indicator
V Voltmeter
F1, F2, F3 Fuses
"The Engineer"
Swain Sc.

FIG. 1—DIAGRAM OF CONNECTIONS FOR B.T.H. AUTOMATIC SUB-STATION

The rotary converter is a compound-wound machine, fitted with end play and overspeed devices, and is fed with three-phase 50-cycle current at a pressure of 3300 volts, transformers being, of course, interposed between the high-tension supply and the slip rings of the converter. There are high and low-tension switchboards, and two automatic re-closing feeders. The high-tension switchgear comprises a two-cubicle board. One cubicle houses the automatic high-tension oil circuit breaker and the other a small power transformer, which provides a low-tension supply for the control circuits. There are four low-tension panels—an alternating-current starting and running panel, an instrument and relay panel, and two feeder panels. In order to ensure that the converter always runs up to speed with the correct polarity, an auxiliary generator is used to excite the machine. Another

field contactor and the machine is ready for connecting to the direct-current bus-bars.

Continuing its travel, the controller then closes the machine high-speed circuit breaker, thus connecting the rotary to the direct-current bus-bars. The controller then comes to rest in the running position, where it remains until the machine is shut down. The rotary continues to run and supply power until it is shut down by a reduction in the load or by the operation of some protective device. The controller always rotates in the same direction, and after a shut-down it must always run on to the off position before another start can be attempted, a normally closed contact being provided on the master control contactor for that purpose. Complete protection is afforded against all possible troubles. As regards overloads and short circuits, the machine panel is

provided with a high-speed circuit breaker—see Fig. 3—and a line contactor. On overloads, the high-speed circuit breaker trips, thereby inserting a resistance in the machine circuit, and by means of an interlock opens the line contactor, and disconnects the machine from the bus-bars. After a short interval, however, the breaker recloses, and if the trouble has disappeared, it remains closed. If, on the other hand, the overload persists, the breaker again trips, and closes as before, after a given interval. The breaker is controlled by a repeat action relay, which can be set for any number of operations, from one to six. It moves a notch each time the breaker opens, and it is provided with a timing device. If the breaker

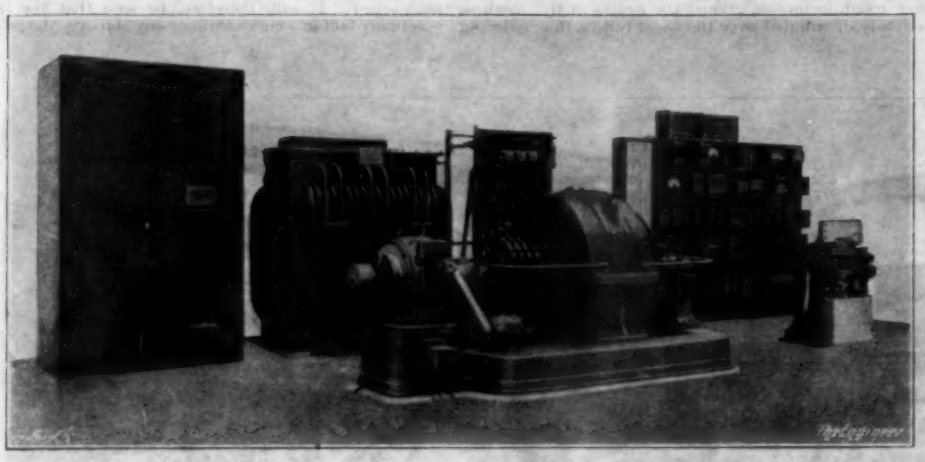


FIG. 2—COMPLETE R.T.H. AUTOMATIC SUB-STATION

should remain closed for a period equal to the time setting, the notches are reclaimed, but if the breaker continues to open without any notches being reclaimed, on taking its last notch the relay operates its contacts and locks the breaker in the open position until the trouble has been investigated, and until the relay has been reset by hand.

If the rotary should attain an excessive speed, the equipment is shut down, and put out of commission until the arrival of an inspector. Should the alternating-current voltage be too low at starting, or if it should fall off whilst the machine is running, the machine is prevented from starting or is shut down, as the case may be, but the machine is free to restart as soon as the normal voltage is restored. The equipment cannot start unless all three phases of the high-tension supply are energised. Moreover, if the rotary should fail to be connected to the direct-current bus-bars in a given time, it is shut down and locked out of commission until the trouble has been investigated. A temperature relay, possessing the same heating and cooling characteristics as the machine, shuts down the plant if a given overload be maintained for a longer period than that for which the machine is designed, but allows it to restart when the rotary has cooled.

Should the auxiliary generator fail to build up its voltage or lose its voltage during running, the equipment is shut down, and locked out of commission. If the machine should flash to earth or if the windings should break down to the frame, the equipment is shut down by an earth leakage relay, and cannot restart until the trouble has been investigated, and the relay has been re-set. As the rotary is provided with an auxiliary field winding which is separately excited from the auxiliary generator which excites the field during the starting period, it is impossible for the rotary to run up with the incorrect polarity. This auxiliary winding, however, is disconnected from the auxiliary generator before the rotary is connected to the direct-current bus-bars, and consequently there is no danger of the polarity of the generator being reversed by heavy faults which might react on the converter field. To allow for remote contingencies, such as the reversing of the auxiliary generator connections after an overhaul, a polarised relay is provided, and this relay, which is always in circuit, must be excited in the correct direction before the machine can be connected to the direct-current bus-bars.

Each bearing is provided with a temperature relay, which, in the event of a bearing overheating, shuts down the plant and puts it entirely out of commission. If the starting motor should overheat, owing to too-frequent starting or in the event of the machine failing to synchronise properly, the plant will also be put out of commission. A reverse power relay prevents the plant running inverted, but this relay is capable of re-setting itself, and the equipment is therefore free to restart. The high-tension oil circuit breaker is fitted with time limit overload trips, and an earth leakage trip. Excessive alternating-current overloads or earth leakage will trip this breaker. As a result, the machine is completely disconnected on the alternating and direct-current sides, and as this breaker is intended only to take care of very serious faults, a shut-down due to this cause puts the equipment out of commission until the trouble has been investigated and corrected. The feeder equipments which were exhibited are designed to demonstrate two schemes. The first is similar to that described above, with the exceptions that a contactor is used in place of the high-speed circuit breaker, and that no resistance is included in the circuit. It is usual to set the feeder relays for three-notch operation, and the machine relay for four, and when this is done a faulty feeder is permanently locked out after three attempts to close, whilst the machine can continue to supply the remaining sound feeders. The second feeder equipment works on a load-measuring principle and is suitable for either stub end or multiple feeders. The opening of the line contactor leaves the feeder connected to the bus-bars through a load-indicating resistance, and if the feeder is supplying an isolated system, the contactor recloses as soon as the resistance of the load has increased to a predetermined safe re-closing value. If, on the other hand, the feeder is feeding into a network where the voltage across the load is maintained by some other station, the contactor will reclose when the difference between the voltage across the bus-bars and the voltage across the load has decreased to a safe reclosing value. The various devices used in connection with these automatic sub-stations are shown in the diagram of connections,

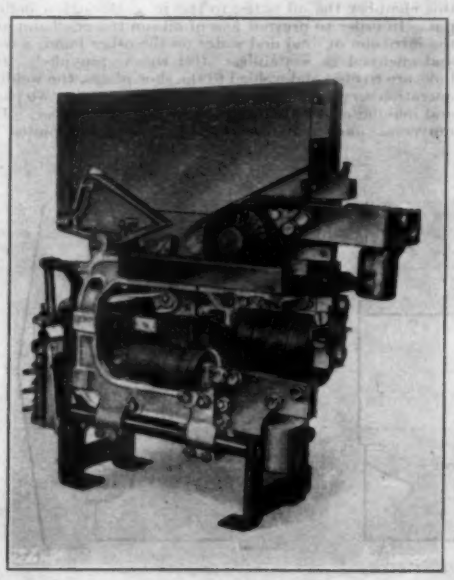


FIG. 3—HIGH-SPEED CIRCUIT BREAKER

Fig. 1. The diagram, it will be noted, is divided into four parts, viz., alternating-current main connections, alternating-current control connections, direct-current main connections, and direct-current control connections.

When the high-tension transmission lines are energised, the control power transformer No. 11 and a potential transformer are energised, each being connected across one phase of the high-tension transmission lines. The control power transformer energises the alternating-current control buses, and provided the voltage of the lines is not abnormally low, the alternating current under voltage relay No. 27 will close its contacts, thus allowing the potential transformer to energise the single-phase starting protective relay No. 32, the contacts of which are in the coil circuit of the master control contactor No. 5. By connecting these relays across different lines, protection against single-phase starting is secured. Assuming that the alternating and direct-current isolating switches are closed, and that all the lock-out devices have their contacts in the normal position, then on a sustained low voltage on the direct-current system, the sequence of operation will be briefly as follows :—

When the voltage on the direct-current system falls, the contact-making voltmeter No. 1 moves on to its top contact, and this energises the time delay starting relay No. 2. After its time setting has expired, this relay closes its relay contacts No. 2 X, which close the master control contactor No. 5, and the solenoid brake No. 34 X is energised. An interlock on 34 X energises the motor No. 34 Y, which operates the master controller. Finger No. 12 on the controller closes the starting contactor No. 10, and the auxiliary field contactor 30 B—shown also on the direct-current control circuit. If the synchronous speed relay No. 13 has not picked up the controller stops at the position C and it waits at position D until the machine has synchronised.

As soon as the machine is in step, the synchronous speed relay No. 13 makes a circuit on its top contact, closes the auxiliary relay No. 13 X and restarts the controller. Finger 14 on the controller completes the coil circuit of the auxiliary contactor 16 X, and the running contactor 16 is closed. An interlock on this contactor closes the full field contactor No. 14, shown on the direct-current control circuit. Finger 12 of the controller is then disconnected from its segment, and opens the starting contactor No. 10 and the auxiliary field contactor No. 30 B.

The controller fingers 17 and 18 close the direct-current line contactor No. 18, shown on the direct-current control circuit. An auxiliary contact interlock de-energises the auxiliary time delay relay 18 X. This relay closes its contacts after a time interval and closes the high-speed circuit breaker No. 54, which connects the rotary to the direct-current bus-bars, and the machine is ready for service.

When the load falls off the direct-current underload relay No. 56 operates, and energises the time delay stopping relay No. 3.

After a time interval the stopping relay opens its auxiliary contacts No. 3 X, and this opens the coil circuit of the master control contactor No. 5, which disconnects the machine on the alternating and direct-current sides. The solenoid brake 34 X is energised by a normally closed interlock on the master control contactor No. 5, whilst an interlock on 34 X energises the motor-operated controller, which rotates and finally stops in the off position. There are many details on the diagram which might be dealt with, but sufficient has been said to give a general idea of the operation of the plant.

THE SOUTH WALES INSTITUTE OF ENGINEERS.

The following programme has been arranged in connection with the South Wales Institute of Engineers' Exhibition, which is to be held in Cardiff from November 27th to December 6th next. On Thursday, November 27th, at 11 a.m., there will be a general meeting of members of the Institute and of the representatives of engineering firms which are exhibiting at the Exhibition. The Lord Mayor of Cardiff (Alderman W. H. Pethybridge) will welcome the exhibitors on behalf of the city, and an address of welcome to exhibitors will be delivered by the President of the South Wales Institute of Engineers (Mr. W. A. Chamen, M.I.E.E.). At 2 p.m. the Lord Mayor will declare the Exhibition open. At 7 p.m. members and exhibitors will be received by the President at the Park Hotel, and at 7.15 p.m. there will be a dinner, open to members and exhibitors.

On the Friday there will be a general meeting of members and exhibitors at 11 a.m. at the Institution's building, Park-place, when films and slides will be displayed by Mavor and Coulson, Limited, of the Universal bar coal cutters cutting a heading and flitting to another, and also slides illustrating the same firm's machines at work in this coalfield ; and films and slides will also be displayed by Hugh Wood and Co., Limited, of the Jeffrey coal cutters and other machines in operation on the surface and underground, as well as slides of the Jeffrey Longwall Arcwall machine, &c.

On the Monday at 11 a.m., at Park-place, there will be a general meeting, when a paper, entitled "The Scientific Treatment of Boiler Feed Water, introducing the Colloidal Aspect," by Mr. W. B. Lewis, assisted by Mr. G. S. Irving, A.M.I. Chem. E., F.C.S., illustrated by lantern slides, will be read and discussed. At 6 p.m. there will be a meeting of members of the Institution of Electrical Engineers (Western Centre), when a paper on "Automatic and Semi-automatic Rectifier Sub-stations," by Mr. G. Rogers, A.M.I.E.E., will be read. Members of the South Wales Institute of Engineers, kindred societies and exhibitors are invited.

On the Tuesday at 7 p.m. there will be a joint meeting of the South Wales Institute of Engineers, the Institution of Electrical Engineers (Western Centre), and the exhibitors, at Park-place, when a popular demonstration lecture, entitled "Modern Electric Lighting," will be delivered by Mr. W. E. Bush, manager, Lighting Service Bureau, E.L.M.A., 15, Savoy-street, W.C. 2. Continuation lectures dealing with different aspects of the same subject will also be delivered by Mr. Bush on the two following days, also at the Institution building, Park-place. This lecture is more especially intended for shopkeepers, members of Chambers of Trade and Commerce, hotels, general users and householders. Ladies are specially invited to this lecture.

On Friday, December 5th, at 7.30 p.m., at the Institution building, Park-place, there will be a conversazione and dance, open to members of the Institute and their friends, and to exhibitors.

Sentinel Track-Laying Steam Tractor.

In order to widen the field of utility of the Sentinel steam road tractor, the makers have now made a further development which will enable this machine to be used for cross-country work where roads are unknown. The development has been effected by making use of the patented chain track system of Roadless Traction, Limited. The outstanding features of this system are:—Lateral flexibility of the track which allows vehicles fitted with it to be steered like an ordinary vehicle; a method of suspension of the track whereby it can conform to any irregularities of the ground; and the mounting of the machine on rubber-tired wheels, which prevents vibration caused by the contact of the track with the road surface from reaching the framework of the vehicle.

The motive mechanism is of the usual type made by the Sentinel Waggon Works, Limited, Shrewsbury. It comprises a twin horizontal high-pressure engine having cylinders 6½in. diameter by 9in. stroke, which can develop about 65 brake horse-power and has a two-throw crank shaft, with cranks set at right angles, which revolve in a completely enclosed crank case. The crank case also houses two cam shafts, which are positively driven from the crank shaft by spur gearing. Their function is to operate the eight poppet valves which control the steam admission and exhaust to and from the cylinders. Each cam shaft has three cams giving two forward speeds with cut-offs of about 37 and 75 per cent. respectively, and one reverse speed. There is also a neutral position on the cam shaft which keeps both the inlet and exhaust valve open. The Sentinel differential gear, which has already been described in THE ENGINEER, April 20th, 1923, is contained in the crank shaft. The boiler is of the vertical water-tube pattern, and is carried in front just to the rear of the front wheels, whilst the engine is situated immediately over the centre of the tracks, and over it are placed the water tank and the fuel bunker. This disposition of the parts gives the most desirable distribution of the weight, by far the greater portion falling upon the tracks themselves.

The front axle consists of a rectangular forging with eyes at either end to take the usual stub axles of the Ackermann type steering gear. It is restrained to movement in a vertical direction by means of a horn plate on either side of the chassis, and it carries the forward part of the chassis by means of a transverse plate spring, thus providing a three-point suspension. This arrangement permits of a considerable amount of independent movement at the ends of the axle without racking the frame.

The suspension of the rear portion of the vehicle is provided for by means of springs, and the entire weight of the vehicle is carried on rubber tires, while the driving sprockets and idler wheels which carry the track are also shod with rubber.

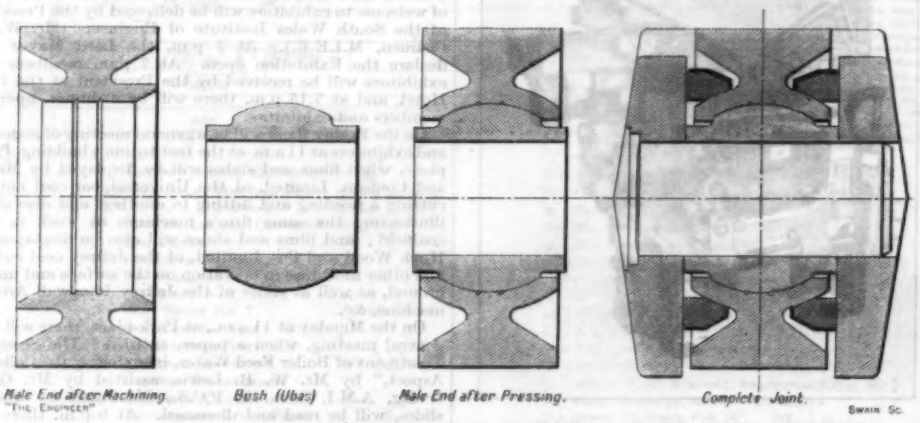
The power of the engine is transmitted to the tracks by means of silent roller chains, a small sprocket on the end of each differential stub shaft being coupled by means of a chain to a large pinion which revolves freely on an intermediate jack shaft. This large pinion is bolted to a second small pinion which, by means of a heavier chain, drives a drum bolted to the main driving sprocket of the track. This arrangement is duplicated on each side of the vehicle. The chains are provided with adjustment for wear as well as with an efficient system of lubrication. Brake drums are formed integrally with the main track driving sprockets, and inside these brake drums internal expanding fabric-lined brake shoes operate.

Each track unit comprises the track itself in the form of an endless chain of metal shoes, the sprocket which drives the track at the rear of the track unit, the idler wheel, and the bogie, which comprises an assembly of rubber-tired rollers in the centre of the track unit. The sprocket and idler are not called upon to carry any of the weight, which is all taken by the bogie. When travelling over rough or uneven ground the weight of the machine is evenly distributed over the bogie rollers, thus reducing excessive vertical loads on the track joints. The shoe plates of the track are steel castings and the links are of heat treated forged steel. The joints—see sketch herewith—consist of hardened and ground steel pins working in bushes of similar metal. The links are so machined that after the bush, which is spherical on the outside, is inserted in the bore of the male end of the link, the metal can be pressed over the spherical portion, thus forming a simple and efficient universal joint. A chamber is provided in each link for holding lubricating oil, and from this chamber the oil is fed to the joint through a hollow pin. In order to prevent loss of oil on the one hand and the intrusion of mud and water on the other hand, a cork seal enclosed in a stainless steel rim is provided. The links are riveted and welded to the shoe plates, the welding operation serving the dual purpose of joining the two parts and making an air-tight closure of the oil chamber. The universal movement between the adjacent plates is limited in each direction to the maximum required by interlocking stops at the outside edges of the plates. The effect of this arrangement is to give to the track a certain amount of lateral flexibility, each shoe being able to adapt itself more or less to the unevenness of the ground. When bending round the sprocket and the idler, the working joint is the pin in the bush, but when moving laterally or rocking transversely, the working joint is the spherical outer portion of the bush in the link. The sprocket wheel is a steel casting, and the teeth in it are purposely made much wider than the track teeth with which they engage, for a reason which will be explained later.

The idler is a double wheel provided with rubber tires. It supports the track on either side of the links, whilst steel flanges engaging with the sides of the links ensure that the track is in correct alignment as it passes over the idler to the ground. The idler is mounted on an arm pivoted with the bogie bracket and is free to rise when obstacles are encountered. The bogie has four rubber-tired cast steel rollers which are mounted on Hyatt roller bearings. They have flanges which, by making contact with the sides of the links, maintain the bogie in correct alignment with that portion of the track which is in contact with the ground. The bogie is free to move in a fore and aft or transverse direction to accommodate itself to the angles assumed by the track plates. In addition, it is also able to turn, as it were, about a vertical pivot which is necessary when the vehicle is being steered.

When steering the operation of the track mechanism is as follows:—Assuming that the front wheels are turned to one side, say, for example, to the right, the idler which is holding the front portion of the track clear of the ground moves parallel to the main train to the right also. That portion of the tractor which is held in contact with the ground by the rollers of the bogie does not move, but the portion which slopes upward from the foremost roller to the idler wheel assumes an angle relative to the portion on the ground, and, as the vehicle moves forward each successive track plate is laid down at an angle with its predecessor. It will, therefore, be seen that the track is actually laid in a curve without any slip over the ground surface. As the track is picked up at the rear end by the sprocket the correct alignment and meshing of the teeth are both ensured by making the sprocket sufficiently wide to allow sideways movement of the track.

TRACK-LAYING STEAM TRACTOR



UNIVERSAL JOINTS OF TRACK

The total weight of the tractor is about 7¼ tons, and the area of the tracks is such that the pressure per square inch of track on hard ground is 17 lb., and as low as 10 lb. in soft ground, when, of course, a greater length of chain is in contact with the earth.

We recently had an opportunity of witnessing the operations of one of these tractors at the makers' works, and were agreeably impressed with the way in which it acquitted itself under varying conditions. Sawdust was sprinkled on the ground in order to show that there was no side slipping of the shoe plates when the vehicle was being steered round a curve. Passing over the hard paved roads from the works to the testing ground there was an almost entire absence of noise arising from the contact of the track plates with the ground. The testing ground was in a very muddy condition owing to the recent rains, and in it was a natural pond which had been deepened to a depth of about 2ft., the bottom being of slimy and soft clay. Through this pond the tractor made its way without any sign of difficulty. A tree trunk about 12in. in diameter was laid on the soft ground, and the tractor was driven over this obstacle to demonstrate that the bogies which carry the load swivel around their axis and allow the track to ride over the obstacle with little perceptible lift of the machine. After this experiment the extraordinary hauling powers of the tractor on solid ground was demonstrated by hitching to it a train of vehicles representing, we were informed, a gross load of 58 tons, which the tractor moved with little apparent difficulty. A still further test of the machine's tractive power was carried out with the aid of a dynamometer, when the pull exerted was shown to be 5 tons 10 cwt. It should be mentioned also that the ground upon which the demonstration took place was all newly made and consisted principally of slag and cinders. It included short and stiff gradients of about 45 deg., or 1 in 1, all of which were negotiated quite effectively, in both directions.

New Dock on the Mersey.

THE deep-water dock of about 18 acres area, which is to be constructed for Messrs. Lever Brothers, at Bromborough on the Cheshire bank of the river Mersey, to provide new facilities for traffic to Port Sunlight, is a most notable example of private enterprise in this field.

At the present time traffic has to be accommodated at Bromborough Pool, which is a creek navigable only at high water, and then by barges, and the need of additional facilities has been obvious for a long time past. After full consideration the bold plan of constructing an entirely new dock, at a total estimated cost of about £750,000, was conceived. The dock will be accessible to ocean-going vessels, and a contract for the construction has just been placed with Messrs. Kirk and Randall, of Westminster. The entire works, which include a foreshore reclamation as well as the dock, will cover an area of about 145 acres at the mouth of Bromborough Pool, and have a frontage to the river of about 1¼ mile. The dock will have a deep-water area of about 18 acres, and includes three quays

of a total length of 2400ft. The approach from the river will consist of a short dredged channel leading to an entrance lock, 75ft. in width, and having a clear length of 120ft. between caissons. The depth of water over the lock sill will be 35ft. at high water of ordinary spring tides and 27ft. at high water of neap tides. Two timber jetties, 190ft. and 240ft. long respectively, built on concrete foundations, will be constructed outside the lock entrance for the assistance of vessels entering the dock. Deep-draught ships will enter and leave the dock near the time of high water, but barges and other small craft using the dock or Bromborough Pool will be dealt with at practically all states of the tide by means of the entrance lock.

During the construction of the dock a temporary service channel, nearly half a mile long and about 120ft. wide, will be constructed, so as to maintain a route for traffic to and from the Pool. This will be the first work undertaken. The next stage of the construction will be the embankment. On the south side of the dock the frontage line of the works will be formed by a mass concrete wall, 3400ft. long behind which a reclamation, amounting to about 50 acres, will be gradually carried out. On the north side the frontage line will be formed by a rubble embankment about 2000ft. long, containing an area to be reclaimed of 52 acres.

No special difficulties are anticipated in the construction. For the concrete wall on the south side of the dock there are, over the greater part of the length, good sandstone foundations, but near the lock entrance there is a large deposit of mud, and it will be necessary to sink a cofferdam and to carry the wall down to a depth of 60ft., or twice the normal depth of 30ft. A cofferdam will also be provided in the site of the entrance lock, and for a section of the quay construction.

Good rail access will be provided from the new dock to the existing line serving Port Sunlight, and it is clear that the dock will constitute an enormous improvement of the transport arrangements. No details of quay equipment have yet been decided. The reclamation of an area of 145 acres is, of course, an important part of the scheme. The reclamation will be of a gradual character, and a considerable time must elapse before the land, which lies between the existing high and low water levels, is in a condition to permit building operations to be put in hand. Obviously, however, it will make an important addition to the area owned by Messrs. Lever Brothers, which is available for development.

It is intended that an immediate start shall be made with the works, the construction of which is expected to take about three years.

The two firms of Messrs. A. J. Barry and Partners and Sir John Wolfe Barry and Partners are joint engineers for the works on behalf of Lever Brothers, Limited.

The Correct Lay for Wire Lines Used Upon Oil Wells.

By J. T. HAYWARD.

Wire ropes of similar construction and dimensions but of opposite lay being identical with regard to price and wearing capacity, the sole consideration governing the choice of lay is the influence the rope may have upon the tendency of the tool joints to unscrew.

In the present paper the lay of a rope is defined in the British and American way, not in the German. That is to say, a right lay is one in which the strands are helically laid like a right-hand screw thread, those in the ropes of left-hand lay being laid in the opposite direction. Some people find it difficult to distinguish rapidly at sight the lay of a rope. A simple method is to picture the letter V in the air between oneself and the rope. If the strands run parallel to the left arm of the V the rope is left lay, and if to the right arm right lay.

Considering the standard cable drilling rig, that is, where one end of the cable is babbitted into the rope socket and the other attached to the bull wheel and not as a rule detached during drilling in order to turn the tools, for this purpose the general practice on the fields upon which the writer has had experience is to use a line of left-hand lay with right-hand tool joints. The same practice is also advocated in the various text-books and rope makers' catalogues. For instance, on page 61 of Mr. John Wells' excellent little book, "Wire Ropes on the Oilfields," the following sentence occurs:—"All drilling ropes are made left-hand lay, unless right-hand lay are specially asked for. The reason for this is that all tool joints are right hand; consequently the twisting of the line tends to tighten up the joints." It is the intention in this paper to question the correctness of the above theory and practice and the conclusion arrived at is that it is wrong.

Let us consider a rope suspended vertically with a scale pan attached to its lower end and free to spin. If a suitable weight be placed in the pan it will be found that the line will untwist, the pan revolving in the required direction. Upon the removal of the weight the line will revolve the pan back or nearly back to its original position. Choosing a line of left-hand lay the pan would, when observed from above, rotate clockwise when loaded and anti-clockwise when unloaded. This is, of course, common knowledge. Let us now try and apply it to drilling conditions.

Suppose that a left-hand line is being used on a standard cable rig, the upper end of the line being attached to the bull wheel and the lower end babbitted into the rope socket. With the beam running there will be a cyclical variation of load in the line which will in turn cause a varying couple to be applied by the line to the rope socket. The tools being free to turn, but possessing angular inertia, will oscillate about a mean position and the couple applied by the rope to them will be alternatively clockwise and anti-clockwise. Now the axial load upon the joint between the rope socket and the top of the jars or sinker will be practically equal to the tension in the rope immediately above the rope socket. When this axial load is great it will, owing to the friction between the threads, tend to lock the joint and prevent it from unscrewing. It will therefore be the couple exerted by the rope when the tension in it is small that will be effective in unscrewing the joint, should this by accident have become slack. We have already seen that the left-hand rope exerts when unloaded a couple that in plan is anti-clockwise, and such a rope would therefore, if used as a drilling line with right-hand tool joints, tend to unscrew the rope socket, while a right-hand rope would tend to set it up. This conclusion is, of course, the reverse of that which the writer believes to be the usual theory.

Reasoning practically similar to that given above would apply to the joint between the sinker and the jars and to that between the jars and stem. The conditions affecting the joint between the stem and the bit will, on the other hand, be complicated by the allowance that must be made for the angular momentum of the tools above this joint when the bit strikes bottom, and the effect of this upon the joint will depend upon the sense and magnitude of the angular velocity possessed by the string immediately before the bit strikes and is brought to rest. Consideration of the vertical accelerations during the cycle, and consequent tensions in, and couples exerted by the rope, lead to the conclusion that with a left-hand lay the angular velocity at striking will be anti-clockwise more often than clockwise and will therefore assist in unscrewing the bit. If the above arguments are correct we are again led to the conclusion that a right-hand rope is the proper one for use with right-hand tool joints.

In order, if possible, to get some practical information on the subject the writer examined several sets of jars that had been used for cable drilling and, as far as could be learnt, used only with left-hand rope. The two halves of a set of jars being in relative motion only when the tension in the lower end of the rope is a minimum, it was expected that opposite faces of the reins would show unequal wear, even though the opening of the jars during normal drilling conditions might be very small. This expectation was not confirmed, the reins appearing to be equally worn on both faces.

Not at the time having the opportunity to carry out full-scale experiments, the writer had a model string of tools made, the scale being one-tenth full size. These were suspended from a spring pole by the "rope" to be tested and worked in a tube containing 2in. or 3in. of sand at the bottom, the arrangement allowing various strokes between 0in. and 6in. to be run. Two 2 m. lengths of duplex electric light flex of opposite lay, but identical in other respects, were selected and alternatively used as the rope, the several joints in the string of tools being consecutively left slack half a turn. With the left-hand rope the loose joint was in each case further unscrewed, fifty strokes being sufficient to unscrew any one of the joints an additional half turn. With the right-hand rope, on the other hand, the joint was in each case set up, fifty strokes being sufficient to make it up the half turn left slack at the commencement. The final result was not affected with either of the ropes by varying within limits the length and/or rapidity of the strokes. Even with a short stroke and the tools working free in the air without striking bottom the screwing up or unscrewing tendency of the rope was effective.

Other ropes were tried, for instance, hemp cords of various thicknesses. The results were similar to those described above, but it was found that as the diameter of the rope was reduced it was eventually unable to overcome the natural tendency of a conical joint to unscrew under vibration and tension; at the same time the tendency to unscrew was always greater with the left-hand rope than with a similar right-hand rope.

It will be seen, therefore, that these experiments with a model confirm the theoretical argument outlined earlier in the paper and contradict the usual theory and practice. It is most probable that other papers have been written on this subject, possibly describing full-scale experiments and vindicating the standard practice. Such work, if it exists, is unknown to the writer, and it is in the hope of hearing other opinions and thus adding to his knowledge that has prompted the writing of the present paper.

Catalogues.

Norton Company, Worcester, Mass., U.S.A.—Four booklets on the Norton floor.

Yorkshire Copper Works, Limited, Leeds, England.—A leaflet dealing with copper tubes.

H. F. Barnett-Smith, Priory-road, High Wycombe, Bucks.—Catalogue on wood-working machinery.

Donovan and Co., Limited, 47, Cornwall-street, Birmingham.—Price list of electrical supplies.

Braithwaite and Co., 117, Victoria-street, S.W. 1.—Brochure on their patented electric capstan for driving screw piles, &c.

The Parsons Motor Company, Limited, Town Quay Works, Southampton.—Publication No. 72 on Parsons industrial installations.

Fuller's United Electric Works, Limited, Woodland Works, Chadwell Heath, Essex.—New radio accessory list 315a and list 321.

Joseph Foster and Sons, 134, Fleet-street, E.C. 4.—A leaflet illustrating and describing the Foster patented four-roll printing and folding machine.

Evershed and Vignoles, Limited, Acton Lane Works, Chiswick, W. 4.—Catalogue No. 1373 of the Ducter low-resistance testing sets.

Hyatt, Limited, 56, Victoria-street, S.W. 1.—Leaflets No. I.N. 38 on the Hyatt mine tub wheel, and No. I.N. 44 on the Hyatt conveyor idlers.

Hollings and Guest, Limited, Thimble Mill-lane, Birmingham.—A leaflet illustrating and describing the Guest "all-metal" bundling press.

J. Blakeborough and Sons, Limited, 199, High Holborn, W.C. 1.—List No. 85, illustrating and describing the Larner-Johnson hydraulic valve.

The English Electric Company, Limited, Queen's House, Kingsway, W.C. 2.—Publication No. 374, entitled "Power House and Substation Switchgear."

The British Insulated and Helsby Cables, Limited, Prescot, Lancashire.—A booklet illustrating buildings in which the Helsby twin wiring system has been installed.

The Westinghouse Brake and Saxby Signal Company, Limited, 82, York-road, King's Cross, N. 1.—Catalogue, Sections S, 4, Supplement 1, S. 8, and S. 10, describing respectively the electric point and lock machine, electric point detection, and interlocking apparatus, style 1924.

Mirrlees, Watson Company, Limited, Scotland-street, Glasgow.—Pamphlet No. Pa. 900, "Mirrlees Steam Condensing Plant, List of Installations."

Marshall, Sons and Co., Limited, Gainsborough.—Publication No. 1448 on the class "S.M.P." vertical steam engine, and publication No. 1451 on the class "S.M.P." horizontal steam engine.

James and Frederick Howard, Limited, Bedford.—An illustrated catalogue, No. 38, divided into four main sections: agricultural implements and machinery; abattoir and meat works equipment; presses; and light railway equipment.

Westinghouse Electric and Manufacturing Company, Limited, East Pittsburg, Pa., U.S.A.—Circular 1661, a catalogue of electrical equipment for railway shops. Leaflet 20,190, a booklet of electric locomotive data.

V & D Refractory Bricks.—A remarkable catalogue, produced by Signor Giuseppe Verzocchi, of Milan, who controls the sale of V & D bricks in Italy. It contains many curious and some beautiful plates in black and white and colours.

Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester.—Special publication No. 7977/4, which gives the full history of the electrification of the Metropolitan Railway. Catalogues Nos. 430/2 and 430/1–1, describing the Metropolitan-Vickers vertical and horizontal water wheel alternators. Leaflet No. 45/1-1, describing the "Vickcon" centrifugal pump. Leaflets No. 400/1-1 and 400/3-1 on induction regulators and vertical induction motors respectively. Descriptive leaflet No. 460/1–1, dealing with steam condensing plant, and Circular No. 1577/1, on tramway motor gears and pinions.

CONTRACTS.

The municipality of Copenhagen has placed another large order for water-tube boilers with the Vickers-Sperring Boiler Company, Barrow-in-Furness. This is the second contract the municipality has placed with that company recently.

The Underfeed Stoker Company, Limited, of Aldwych House, Aldwych, London, W.C. 2, has recently received orders for sixteen travelling grate stokers, eighteen Underfeed stokers, three air heaters, three sets of suspended arches, and for nine ash-conveying plants.

Contracts for 250 tube wagons have just been placed by the London, Midland and Scottish Railway with the following firms:—Metropolitan Carriage and Wagon Company, Limited, 100; Midland Railway Carriage and Wagon Company, Limited, 50; and Hurst, Nelson and Co., Limited, 100. The wagons, which are to have steel underframes and wood-lined tops, will be 27ft. in length and of 20-ton capacity. The new stock is intended for use in Scotland for the conveyance of tubes, bar iron, &c.

Alexander Jack and Co., Limited, Whitegates Engineering Works, Motherwell, have recently received orders for one 60-ton three-motor overhead electric travelling crane, 51ft. span, for Dundee Corporation Electricity Department; for one 60-ton four-motor overhead electric travelling crane, 77ft. span, for the Victoria Falls and Transvaal Power Company, Limited, to be delivered, erected and set to work in its new power station on the Rand, South Africa; and for one 45-ton three-motor overhead electric travelling crane, 45ft. span, for the city of Carlisle electricity generating station.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We understand that Tanks and Drums, Limited, of Bowling Ironworks, Bradford, is extending its works to cope with the increased demand for its products.

We are asked to state that Mr. Godfrey Isaacs has been obliged, under doctor's orders, to resign his position as managing director and deputy chairman of the boards of directors of Marconi's Wireless Telegraph Company, Limited, and of the Marconi International Marine Communication Company, Limited, but that both companies will continue to have the benefit of his assistance in a consultative capacity. The Right Hon. F. G. Kellaway, P.C., has been appointed to succeed Mr. Isaacs as managing director and deputy chairman of the respective companies.

Fiat Motors, Limited, of 43–44, Albemarle-street, London and Wembley, Middlesex, has for many years been sole concessionnaire for the United Kingdom of Great Britain, Northern Ireland, and latterly the Irish Free State for the sale of Fiat motor cars, manufactured by the Fiat Company of Italy. A new company, styled Fiat (England), Limited, has now been registered to take over the concession hitherto handled by Fiat Motors, Limited, and the sale of other products of the Italian company. Mr. D'Arcy Baker who has for the past twenty-one years been in charge of "Fiat" interests in the United Kingdom and Ireland, will retain that position, and, in addition, will become chairman of the board of directors of the new company.

British Engineering Standards Association.—The B.E.S.A. has just published Publication No. 192, 1924, dimensions of British standard spanners, in which are given all dimensions necessary for setting out spanners to the new British standard design, up to 2in. nominal size. Dimensions for British standard spanners were published in the Association's Report No. 28 in 1908, but owing to criticisms on the design in that report, it has been re-considered, and the British standard spanner now recommended is based on a design which has been well tried out in practice. The table of dimensions is preceded by notes regarding the angle between spanner head and shank, and the method of marking, which provides for marking with both the B.S.W. and B.S.F. bolt sizes. Copies of this publication may be obtained from the B.E.S.A. Publication Department, 28, Victoria-street, London, S.W. 1, price 1s. 2d. post free.

The Institution of Automobile Engineers.—In one of the lesser halls of the Connaught Rooms the Institution of Automobile Engineers held its annual dinner on Wednesday last. It was marked by that lightness of spirit which has always characterised those events. The speeches were excellent, never too long, and all with that touch of irresponsibility that is appropriate after dinner, and that at such times may profitably be used to temper profounder utterances. Dr. Ormandy, the President, occupied the chair, and responded to the toast of "The Institution," happily proposed by Sir Edward Manville. It was interesting to observe the cordiality with which the President's remarks that the graduates should seek a liberal education and avoid too early specialisation in engineering was received. It is clear that the world is coming round to the view that we are sacrificing too much in our present methods of vocational and technical training. After this brace of speeches, we listened to some excellent singing, and then Mr. W. J. Tennant proposed "The Guests," in a speech that in its kind was perfect—a mixture of sense, wit and banter that delighted the audience. It was acknowledged by Lady Parsons and Mr. A. Brampton, and then at the suggestion of the President, the members and guests moved about the hall making new, and strengthening old friendships.

Natal Iron Industry.

The Newcastle Ironworks, which are situated at Newcastle, in Natal Province, seem to be within a measurable distance of commencing to produce pig iron. Some considerable time ago the company concluded the erection of an up-to-date blast-furnace with two hot blast stoves, blowing engine, dust catcher, gas main, bunkers with gantry, furnace elevator and hoist house; in fact, it is fully equipped in every respect. Unfortunately, however, when the works were completed the company's capital was exhausted, and although on several occasions negotiations with British firms had nearly been brought to a successful issue, as far as the obtaining of the further capital required, is concerned, there was always some hitch.

The inability to begin operations is all the more regretted in South Africa, because the Newcastle blast-furnace is the only plant of the kind so far erected in the Union, and the production of native pig iron would be heartily welcomed by the large engineering works on the Rand, which at present have to pay £12 per ton for imported pig iron, whereas it is calculated it could be produced at Newcastle at less than half that price. The obtaining of cheaper pig iron would enable the big engineering works and foundries on the Rand to extend their operations considerably, and much of the machinery, including agricultural machinery and implements, at present imported would be made in the country. Just now, as, indeed, they have been doing for years past, these works on the Rand—and in other parts of the Union—are working on the large quantities of scrap which had accumulated, but the stocks are coming to an end, and it is therefore considered imperative that pig iron should be produced locally if it is to be possible to compete with oversea works, which at present can undercut in price very considerably, owing to the prohibitive cost of pig iron when imported and railed up country.

The capacity of the plant at Newcastle as at present erected is 150 tons of pig iron per day. It is stated that about 5 tons of raw materials—ore, coal and limestone—would be required to turn out a ton of ore. Therefore 750 tons of raw material would have to be dealt with per day, in addition to 150 tons of the finished product, which means that in all 328,500 tons would have to be dealt with annually by the railways. The traffic would, it is estimated, provide them with an additional revenue of about £58,000 per annum. Employment would also be furnished at once for a considerable number of Europeans, and, furthermore, the great developments which are confidently looked forward to when once the industry is on its feet, would, it is anticipated, give employment to hundreds of other whites and a much larger number of coloured workers.

Negotiations are at present going on between the company and the Government, the former being wishful to obtain payment in advance of the bounty of 15s. per ton for each ton of pig iron produced in the country from local iron ore, which Parliament has agreed to pay, provided that 50,000 tons per year are produced. It is proposed to employ the money thus obtained as working capital. If it succeeds in its endeavour the company would receive £37,500, that being the amount of the bounty for one year's production, and it is stated that that sum would be sufficient for the company's requirements. If the estimate of the annual extra railway revenue be correct, it would amount to £20,000 more than the bounty for the first year.

The Government, it is understood, is not unfavourably disposed towards the proposal, but at a recent meeting between the Minister of Mines and the chairman of the company, the latter was asked to obtain and put certain particulars before the Minister, among which, it is stated, was the quantity of iron ore of suitable quality which could be relied upon.

Much interest is being shown in Newcastle at the prospects of obtaining the bounty, because it is realised that if the works were started new life would be instilled into the town and district.

Improved Warp Damper for Looms.

Many attempts have been made in the past by inventors to provide a satisfactory appliance for effectively damping the warp threads in textile looms, but the problem is not an easy one to solve. The chief difficulties encountered have been the control of the amount of moisture and its even distribution across the threads so as to keep them all equally flexible. Mather and Platt, Limited, Manchester, have been at work on the subject for some time, and claim that with the apparatus which we illustrate in Figs. 1 and 2 both these difficulties have been effectively overcome. Looms equipped with the new form of warp damper have been tested under practical conditions for about two years, and we are informed that, owing to the regular damping, the reduction in the number of "broken ends" has been remarkable. The apparatus has the further desirable qualities, of simplicity and accessibility. Referring to the illustrations which show the Mather and Platt damper applied to an ordinary loom, it will be seen that it consists of a tube E extending across the width of the loom and carried adjustably in brackets C. This tube is supplied with water from the inverted glass bottle P connected to the tube E by means of flexible tubing Q, and along its lower surface is a strip of felt which serves to distribute the moisture equally along a woven porous fabric roller F. The damping of the warp threads is accomplished by pressing the moistened fabric F intermittently against them just as they leave the vibrator or back rest of the loom. An upward and downward movement is given to the damper through an arc of a circle by the mechanism shown. The downward pressure is brought about by means of a helical spring L, and the upward stroke is made by a rod J and strap K actuated by an excentric on the bottom shaft of the loom. Means for adjusting these movements are provided on the spring and excentric, so that the requisite damping can be effected. The reciprocating motion of the damper being controlled by the excentric is accurately timed to harmonise with the movements of the loom. When the loom is stopped with the shuttle in the box at the starting handle end the damper is raised from the yarn and remains out of contact so long as the loom is at rest, thus preventing over-damping. It will be observed that all parts of the mechanism with the exception of the excentric are above and clear of the warp threads, so that accumulations of fluff and size are prevented, while the use of a glass bottle enables the operative to see at a glance whether the supply of water is adequate.

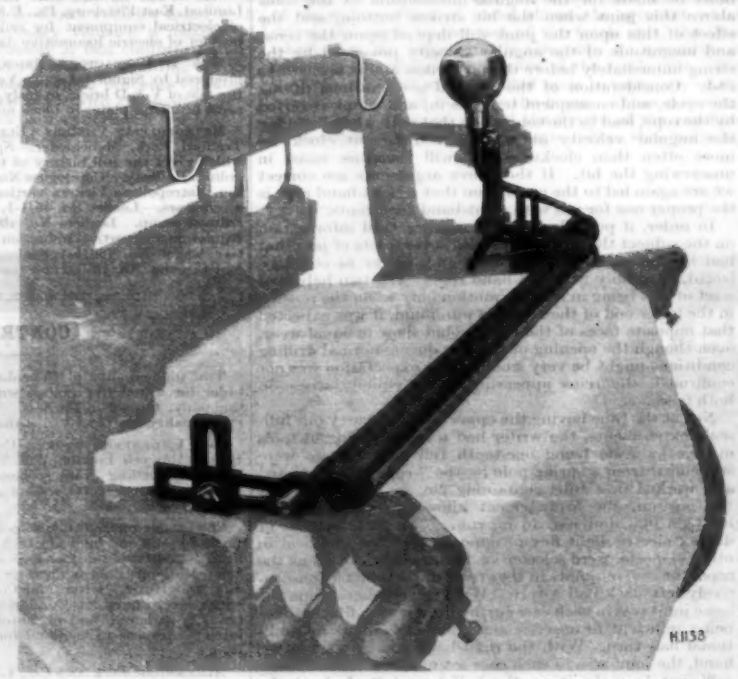


FIG. 1—WARP DAMPER—MATHER AND PLATT

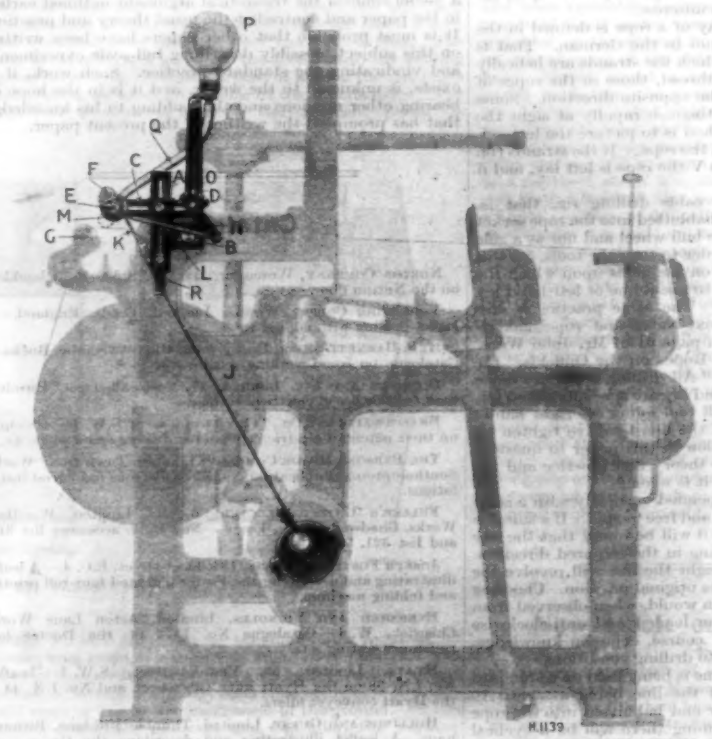


FIG. 2—SIDE VIEW OF DAMPER SHOWING CONSTITUENT PARTS

The Motor Tanker British Aviator.

The sea trials of the new motor tanker British Aviator took place at the beginning of August and they were characterised by singular success. This vessel, which was built by Palmers Shipbuilding and Iron Company, Limited, for the British Tanker Company, Limited, is notable because she is the first ship to go to sea with 3000 shaft horse-power engines of the Camellaird-Fullagar type. The British Aviator may be counted among the comparatively few high-powered single-screw motor ships in operation, and Messrs. Palmers are to be congratulated on the success which has attended their efforts. The upper illustration on page 586 shows a view of the ship taken during her trials on the North-East Coast, and serves to indicate her general lines and appearance. She is classed 100 A 1 at Lloyds, and is of the two-deck type with a poop, bridge and forecastle. The hull was built on the longitudinal system of framing, and the following are the principal particulars of the hull and propelling machinery:—

Hull.

Overall length between perpendiculars	440ft.
Breadth extreme	57ft.
Depth to upper deck	33ft. 11in.
Deadweight capacity	10,000 tons.
Displacement	14,590 tons.

Machinery.

Type	Single-screw Palmer marine oil engine built under Camellaird-Fullagar patents.
Number of cylinders (opposed pistons)	6.
Diameter of cylinders	23in.
Stroke	36in.
Normal speed	90 revs. per min.
Speed of vessel	10 to 12 knots.

The lower of the illustrations given on page 586 shows a view of the engine taken on the test bed. In accordance with the usual design of Camellaird-Fullagar marine engines the two adjacent cylinders are grouped into one casing, the top and bottom pistons of the adjoining pairs of cylinders being connected by diagonal rods. The appearance of the engine is, therefore, not dissimilar from a three-cylinder engine, but each group contains four pistons. With regard to scavenging air, the well-known rectangular form of scavenging pump, formed by the crosshead guide chambers in the upper part, has been retained, and light delivery valves are used. The scavenging air passes from the pumps to a tee-shaped connecting pipe between the cylinder heads and thence to the scavenging air belt, which serves the main cylinders. The scavenger air main serves to brace the engine framing, and a noticeable feature of the trial was the very little vibration discernable on the top platform. By arranging the exhaust ports at the top of the cylinder and the scavenging air ports at the bottom, very thorough scavenging is obtained. The compressed air required for injecting the fuel into the cylinder is furnished by a four-stage air compressor mounted on the bed-plate and driven from the forward end of the main crank shaft. Three auxiliary pumps, for forced lubrication, piston and cylinder jacket cooling water are provided at the back of the engine, and are driven by link gear. A central control panel is provided on the lower platform which comprises astern and ahead running controls, and means for regulating the lift of the fuel valves and also the lift of the fuel pump suction valves when slow running is required. Near the control handwheels is a lever regulating the amount of air delivered by the air compressor. Mechanical lubricators are placed on each of the front main cylinder and compressor columns, and are within easy reach and sight of the attendant on the bottom platform. The second platform gives access to the reversing and manœuvring mechanism.

During the test-bed trials, which took place earlier in the year, some commercial oil fuel consumption trials were run under the supervision of Professor Hawkes, of Armstrong College, with the following results. The fuel used was Anglo-Persian Diesel oil:—Full power, 0.405 lb. per brake horse-power per hour; three-quarter power, 0.404 lb. per brake horse-power per hour; half power, 0.422 lb. per brake horse-power per hour; one-quarter power, 0.463 lb. per brake horse-power per hour. These fuel consumption results include that necessary to produce the power required to drive scavenging

pumps, forced lubrication and piston and jacket water-cooling pumps.

The ship's auxiliary machinery consists of two 60 kilowatt Atlas-Diesel-driven generators, each set designed to be capable of dealing with the full load at sea, which includes the following electrically driven auxiliaries:—Cooling water pump, bilge pump, sanitary pump, oil transfer pump, general service pump, forced lubrication stand-by pump. The following steam-driven auxiliaries are also fitted:—An auxiliary air compressor capable of delivering 450 cubic feet of free air per hour at 1000 lb. pressure; one ballast pump, which also acts as a stand-by to the cooling water pumps driven by the main engine. The steam-driven pumps include a fire and bilge pump, a feed pump for the donkey boilers, and an auxiliary electrical generating plant. Other engine-room auxiliaries are the refrigerator, evaporator and distiller, with an oil-burning installation for the donkey boilers. These boilers are also equipped for waste heat recovery by means of the hot exhaust gases.

The sea trials were carried out on August 7th and 8th in the presence of a large company of guests. On the first day the engines were run at various speeds up to full speed, both on the measured mile and again for some hours afterwards. The power developed was 2887 shaft horse-power, and the speed 11.65 knots. On the second day the engines were run for some hours at the normal service speed, and during the whole of the trial the machinery ran to the complete satisfaction of all present. A notable feature, which was much commented upon, was the almost entire absence of vibration which was due to the smooth running of the engine. On one run a speed of 11.7 knots was obtained with the machinery developing 2950 brake horse-power, corresponding to 3720 maximum indicated horse-power, at 82.5 revolutions per minute. This result was obtained with an oil fuel consumption of 0.408 lb. per brake horse-power per hour, using Anglo-Persian Diesel oil of 18,900 B.Th.U. calorific value.

It may be noted that these results were obtained with the centrifugal oil purifiers, which are installed, not in action. At a reduced brake horse-power of 1920, corresponding to an engine speed of 72.8 revolutions per minute, the speed of the vessel was 10.58 knots, and the oil consumption 0.404 lb. per brake horse-power per hour.

When the exhaust gases were passed through the boiler it was found possible to raise the steam to a pressure of 9 lb. per square inch at full power.

The trials of this vessel were regarded to be of a highly satisfactory character, and they passed off without any hitch. After further tests had been carried out at sea on August 11th and 12th by the Marine Oil Engine Trials Committee, the vessel sailed on her maiden voyage for Abadan the following day.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Outlook Still Improving.

An atmosphere more favourable to trade recovery is steadily developing. The marked improvement in the tone of the Midland iron and steel market, noted in my letter last week, continues to gain strength, and both producers and consumers are hopeful of increased business before the year is out. At to-day's meeting in Birmingham the new business forthcoming was not quite up to the standard of the previous week, but sellers were not in the least discouraged. It was noted with interest that continental producers of iron and steel are getting tired of the cut-throat competition on which present selling values rest. Though such advances as they have effected up to now make little essential difference to the gap which divides native and foreign prices in many departments of the trade, if the advances continue they will undoubtedly increase the chances of a return to the use of native raw materials. Some attention has been given this week by ironmasters to the general trade situation, as shown by the returns of imports and exports for the past month, and it is observed that while the imports show a further increase in the iron and steel products landed at our ports from the Continent, exports of British material underwent a discouraging contraction.

Steel.

In the steel department the situation continues bright, though there has been a slight falling off in demand in some quarters. In others there has been some expansion of business, which rather suggests a more favourable prospect than was looked for a month or two ago. A lull has followed the recent demand for constructional steel; but there is a confident feeling, especially in view of the large schemes already outlined by the numerous municipalities, many of which will call for steel and cast iron pipes. It is believed that the placing of orders in respect of these will not be long delayed. The question of steel prices is under consideration, a special meeting having been called, which may possibly lead to an advance; but the capacity is now so much beyond present demand that the general disposition is to move cautiously with a view to large production. Up to the present efforts to raise the general level of steel prices have been futile, but there is less underselling. Angles and joists are quoted £9 5s., and tees £10 5s. One of the effects of the improvement in trade has been to stimulate the renovation of plants, boilermakers being busier, and the demand for boiler plates has improved. Prices remain firm at £13 10s. per ton delivered in the district. The rise in continental steel has continued, and shippers are showing some reluctance to quote. Soft billets are still bought at about £1 under the home price, however. The advance in continental prices is attributed to heavy buying in France and Belgium on account of Germany, by way of forestalling the new imposts which are expected in the new year. Some of the Belgian steel works are sufficiently furnished with orders to withdraw from this market. It is worthy of note that the output of steel ingots and castings last month amounted to 678,500 tons, compared with 645,000 tons in September, and 702,200 tons in October, 1923.

Raw Iron.

Pig iron business has fallen off somewhat this week, buyers having apparently covered their requirements for some time. However, many Midland furnacemen have taken orders during recent weeks which have sensibly relieved their anxieties with regard to stocks. Moreover, prices have again turned upward. Furnace owners have the justification that on the late narrow basis of business they have been unable to make ends meet. At the weekly meeting in Birmingham to-day sellers were sounding the market to see whether the new conditions would stand a further increase of price, but they received no encouragement. Derbyshire furnacemen who tentatively named £4 3s. 6d. for No. 3 foundry iron found it a bar to business. There can be no denying that a firmer undertone exists, and it is reasonable to suppose that if sellers exercise restraint in regard to prices it will be all to the good. Forge iron is in rather better request, though the market remains contracted. Northamptonshire furnaces are quoting about £3 12s., while Derbyshire makes have sold at £3 17s. 6d. Foundries have been operating more freely. Northamptonshire No. 3 commands £3 16s., while in some cases smelters require more. For Derbyshire No. 3 the general quotation is £4 2s. 6d. The £4 1s. 6d. figure has not entirely disappeared, however. Supplies are abundant and there is no such pressure of demand in any department as to support more than a very limited appreciation of raw material. The demand does not justify the lighting of more furnaces. It is pleasant to be able to record that the production of pig iron in October showed a slight increase in output, amounting to 586,400 tons, compared with 569,200 tons in September, and 595,700 tons in October, 1923. The output includes 192,900 tons of hematite, 185,300 tons of basic, 157,700 tons of foundry, and 28,500 tons of forge pig iron. The number of furnaces in blast at the end of the month was 171, an increase of one since the beginning of the month, 7 furnaces having been blown in and 6 damped down or blown out.

Bar Iron.

The Staffordshire finished iron trade continues to share in the general trade improvement, but there is still a lot of idle plant and considerable additions to order books will be required if mills are to keep running. There is perhaps a little more disposition on the part of consumers to look ahead, there being a few signs which inspire the hope that the industry may look for some improvement in the near future. Marked bar houses report a steady inquiry with good order books. They are easily able to maintain the £15 standard. For medium qualities makers have succeeded in booking contracts for forward delivery, a feature which has been absent for several months. Manufacturers are keen to take the earliest opportunity of putting up prices as they complain that, with high wages and dear coal, present prices leave no profit. Crown bar quotations for the present remain at £12 15s., with nut and bolt qualities £1 less. There is a moderate demand for wrought iron gas tube strip at £13 5s., a number of firms still preferring that material to steel. In this department the tube makers have an advantage over Germany, which does not produce iron tubes. Ironmasters who are devoting their attention to the re-rolling of steel report a brisk trade. Orders continue to be fairly plentiful, and one Black Country firm is stated to be booked up until well after Christmas. This firm is using chiefly native raw material, which is an exception to the general rule.

Galvanised Sheet Prices.

The fall in galvanised sheet prices has been arrested. Mills having strengthened the weak places in their order books, have apparently arrived at an understanding relative to selling prices. The relapse had taken the minimum very near to £17, but on 'Change in Birmingham to-day—Thursday—£17 10s. was generally quoted for 24-gauge corrugateds. Some makers asked an additional half-crown, but that did not meet the ideas of consumers. For 30 gauge, the price has remained steady at £23 15s. f.o.b. Flat galvanised sheets of 22-gauge have been done in special circumstances at £18.

New Engineering Club.

A scheme of considerable interest in Midland engineering circles was inaugurated on Wednesday, when Sir John Dewrance, K.B.E., past president of the Institution of Mechanical Engineers, formally opened a new Engineering and Scientific Club, at Queen-street, Wolverhampton. Such a scheme has been talked of in Birmingham for years, but it has remained for Wolverhampton to take the lead. The scheme has the backing of most of the leading firms in the district and also of prominent public men, and while it will serve primarily as a club, it will also, it is hoped, become the home of such local organisations as the Engineering Society, Civil Engineers, Mechanical Engineers, Electrical Engineers, Automobile Engineers, &c. The idea is to make the club the centre for all engineering societies in the various branches and the scientific societies associated with the chemical and other industries.

Midland Towns and Steel Houses.

Several Midland towns are experimenting with steel-framed houses similar to those recently constructed of steel at Blackpool. It is considered that apart from being considerably cheaper than brick buildings, they can be erected much more quickly and require less skilled labour. The Housing Committee of Dudley Town Council has recommended the erection of twenty houses of steel on a site belonging to the Corporation in the Trindle-road, and it is considered probable that some hundreds of similar houses will be erected at Netherton in the event of the proposed experiment proving satisfactory. Walsall builders have been invited to watch the erection of two steel frame houses at the Walsall sewage farm. It is claimed that the house frames can be run up quickly, and the roofs put on in the course of twenty-four hours.

£76,000 Sewerage Scheme.

The Sedgley, South Staffordshire, District Council proposes to embark upon a rather large undertaking in the shape of sewerage and sewage disposal works at Lower Gornal. The scheme is estimated to cost some £76,000, and application has been made to the Ministry of Health for sanction to borrow that sum. The Ministry's representative has held an inquiry, and it is thought the scheme will commend itself favourably to the Health Authorities. It is understood that 75 per cent. of the total cost will be found, if the works proceeds, by the Unemployment Grants Committee.

Contracts for Midland Firms.

Contracts for 250 tube wagons have been placed by the London, Midland and Scottish Railway with the following firms:—Metropolitan Carriage and Wagon Company; 100; Midland Railway Carriage and Wagon Company, 50; Hurst, Nelson and Co., 100. The wagons, which will be 27ft. in length and of 20-ton capacity, are intended for use in Scotland for the conveyance of tubes, bar iron, &c.

Wednesbury Tube Works' Fire.

Thousands of pounds worth of damage is estimated to have been caused by an outbreak of fire which occurred on November 13th at the works of John Spencer, Limited, Globe Tube Works, Wednesbury.

Fewer Workless.

The increase of 998 in the number of persons unemployed in the Midlands last week has been more than wiped out. The latest returns show that there has been a drop on the week of just over 2000 in the total number, half of which decrease is accounted for by Birmingham. The total has fallen from 145,876 to 143,871. The figures in Birmingham have receded from 34,823 to 33,832, and at Coventry from 2964 to 2741. Decreases were also recorded at Cradley Heath, Dudley, Oldbury, Smethwick, Stourbridge, and Brierley Hill, Tipton, Walsall, West Bromwich, and Wolverhampton. An increase of 244 was recorded at Bilston, but this is the only Black Country town where the figures have not declined.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER.

General Outlook.

The markets here for iron and steel are quiet and steady this week, but without any new feature. The non-ferrous metals are perhaps rather more active than iron, but there is no very prominent activity in any department. Buyers are now waiting to see whether the recent spurt in the iron trade has anything behind it more substantial than sentiment. There is, of course, no doubt that an optimistic sentiment is very effective in starting a market on the upward track, but it must have subsequent support in the improvement of trade, and this is what we are all waiting for in Manchester. Much of the recent optimism was based upon the belief that in Lancashire we were near to a great improvement in the cotton industry and that view may yet be correct, but things are not at all certain with regard to the expansion in this industry, and the buying in iron and metals in anticipation of the improvement has received a check. Nevertheless, the markets all round are much better than they were, and some fair increases in the prices have been secured.

Metals.

The markets for non-ferrous metals are rather firmer all round, although copper prices do not advance very rapidly. The feeling as regards copper is, however, more favourable than it was, and this is probably on account of the publication of American official statistics. These had been held back for a long time, and as a consequence a suspicion had grown up that they must be very unfavourable; but it is now clear that as regards both production and consumption, they are not at all unfavourable, and this sinister suspicion is removed. At the same time, Europe has become a better buyer of American copper. The rise in the value of sterling tends, of course, to lessen any advance in copper prices, but it is perhaps worth noting that standard copper in London is now quoted at fully £2 per ton above the level at the beginning of October. Any very rapid advance in the selling prices would, no doubt, lead to a sharp increase in output; but so long as the upward movement is slow and moderate, we need not fear this. The fact that refined copper is beginning to be of more interest to buyers on the London Exchange is not altogether without significance. It may mean that the market is resting more on actual consumptive business than on speculation in standard copper. After so many disappointments, one does not like to feel at all sure as to the future, but the appearance of things is more favourable than it has been for some time. If consumers once realise that the lowest prices have been seen, and begin to build up stocks instead of relying upon hand-to-mouth buying, the copper market will be in a very much better position. Tin has been fluctuating much as usual, but it is noticeable that the limits between which these fluctuations occur are gradually becoming higher. There are many people here who take a favourable view of the tin market, and believe in higher prices before the end of the year. The steady and large decline in the visible stocks of unsold tin, which has occurred during the last eighteen months, seems to point to the theory that the world output of metal is not now equal to the rate of consumption. Lead has again been a very strong market,

and although it is a little difficult to believe in the permanence of such prices, our difficulty is perhaps a prejudice left from the time when lead at £20 per ton was thought extravagantly dear. Spelter has again shown some improvement, and is quite a firm market.

Pig Iron.

The market here for foundry iron is a little quieter than it was, and there is not so much buying; although sellers here seem very satisfied with what has been done in foundry qualities. At the same time, it would be more satisfactory if the demand for forge iron in Lancashire and for the steel-making irons in the other districts were better. Forge iron is certainly very much neglected as compared with foundry. The usual price now quoted here for No. 3 Derbyshire foundry pig is 90s. per ton delivered, and it may be doubted whether anything less than this would be accepted; but apparently there is now no probability of any further advance this year. The greater number of Lancashire ironfounders have provided themselves with supplies, certainly up to the end of the year, and in some cases well into the New Year; and some of this iron is bought with the view to an improvement in the demand for castings, which has not yet been actually realised. The revival in the textile machinery trade of the district is fully expected, but at present it is mainly expectation. It would, of course, bring a good deal of new business to the Lancashire ironfoundries, and lead to a large consumption both of common iron and of Scotch iron. The latter is more firmly held now, and as a rule 107s. 6d. per ton delivered in Manchester is asked for it. Hematite iron is perhaps a little better than it was, but it remains very cheap compared with Scotch iron in Manchester.

Finished Material.

There is at the present moment not much more than a better feeling to be reported as regards manufactured iron and steel in this district. One finds keen competition for any orders that come into the market, and this, of course, tends to check any attempt to raise the prices. One comes across sellers who are bold enough to quote £9 2s. 6d. per ton for joists and angles, but there is no doubt that this class of steel can still be bought at the old price of £9. For common plates from £9 15s. to £10 per ton is quoted. The reports from the Continent are still fairly favourable, but continental steel, although firmer and dearer, is still very much too far below British prices. Joists, for instance, are still to be had at £6 per ton f.o.b., which would mean £2 per ton less than the lowest British price when delivered in Manchester.

Scrap.

There has been some improvement in the demand from Sheffield for heavy steel melting scrap, and although dealers here are rather chary about raising their prices when buying in Lancashire, it may be presumed that heavy steel melting scrap has now seen its lowest for some little time. In the foundry scrap market, there has been practically no change. It is possible that the demand here is a little better, but good scrap can still be bought at 80s. per ton delivered. About the same price is current for heavy wrought scrap iron delivered at the Lancashire forges.

John Moffatt McElroy.

Much regret is felt in Manchester at the death of Mr. John Moffatt McElroy, who served this city very faithfully and well as general manager of the tramways from the time they were taken over in 1901 until his retirement, owing to ill-health, in 1922. It is generally believed that his illness was brought about by the strenuous work which Mr. McElroy performed during the late war for the Admiralty, the Board of Trade and the Ministry of Munitions. His experience of street passenger transport dated back as far as 1880, when he was employed in the Highways Department of the Corporation. At that time this department had in its charge the supervision and licensing of the horse-drawn tramways which were owned by a private company, and when this service was municipalised, Mr. McElroy was appointed secretary and adviser to the Tramways Department, with a staff of seven persons. Later he was appointed general manager, and it was under his management that the system was afterwards electrified. During the time that he was in charge the department grew from one of seven persons until it employed over 4000. In this period he visited the chief cities of Europe and America several times, in order to study street passenger traffic problems, and the results of his travels were embodied in the remarkable report on the subject which he presented to the Corporation in 1914. It is generally acknowledged that the splendid tramway service which Manchester possesses is largely the outcome of Mr. McElroy's individual efforts. He was a member of the Tramways Joint Industrial Council, representing the Lancashire and Cheshire area, and was one of the founders of the Municipal Tramways Association.

Manchester Association of Engineers.

At a meeting of the Manchester Association of Engineers, held at the Engineers' Club, on the 14th inst., a paper was read, entitled "The Practical Significance of the Inner Structure of Metals," by Messrs. W. E. W. Millington, M. Inst. C.E., Wh. Ex., and F. C. Thompson, B.Sc. In the course of their paper—which was illustrated by models—the authors described the regular atomic structures existing within the crystals of some of the metals used in engineering, and it was pointed out that it was to a very large extent these atomic arrangements which governed the behaviour of metals under stress, and particularly at the elastic limit. The existing theories of elastic failure were summarised, and the authors by a process of argument developed a new hypothesis of elastic failure. Consideration was given to the following factors influencing any law of elastic failure:—(1) The elastic limit itself; (2) the grain size in the material; (3) free surfaces; (4) internal stress; and (5) stress distribution. Referring to the existing theories of elastic failure, the authors stated that so far as could be made out from the mass of published arguments and experimental data, any one of the theories could be proved or disproved, and the question remained therefore in an obviously unsatisfactory state. Almost without exception the evidence and arguments adduced had assumed that the material was homogeneous and isotropic, and, further, that the atomic arrangement within it was without influence on the problem. Recent work of the authors had shown conclusively that the atomic arrangement within a crystalline material had a profound influence upon its behaviour under stress, and it was therefore only logical that, in the consideration of elastic failure, this subject should be taken into account. It was from this point of view that the matter was dealt with by the authors, who paid particular attention to the experiments of Cook and Robertson on thick steel cylinders under stresses in three dimensions.

BARROW-IN-FURNESS.

Hematites.

The position in the hematite pig iron trade of North Lancashire and Cumberland is improving, and the promises of better trade already reported are being fulfilled. There is no big rush of business, but more trade is coming to hand, and there is a better show of confidence. Inquiries are now being made for forward deliveries of metal. The production of iron has been far from the normal for some time, and stocks have been on the increase; but this tendency has now been checked. Iron is being withdrawn from stock, and there is reason to hope that by the end of the year there will be a clearance and additional furnaces put into operation. A furnace was put into blast at the Ulverston Ironworks last week-end. So far as Barrow is concerned, steel makers are again in the market for local supplies, and overseas trade is a trifle better. Prices are firmer.

Iron Ore.

The demand for iron ore is largely a local one, and with furnaces going on to a fuller output in place of easy blast, it has been necessary to increase the ore output. The Peckermet Mines, in Cumberland, owned by the United Steel Company, Limited, are again in operation, after being idle for quite a lengthy period, and at the Roanhead and Anticross mines, near Barrow, the men are now on full time. The Hodbarrow Mines, where the highest grade metals are raised, are now busier. The importations of foreign ore are quiet.

Steel.

The prospects in the steel trade are rather better, but there is not much life in the demand. The Barrow Steel Company is in receipt of an order for steel rails from the New Zealand Government, and the Siemens plant and the rail mill and other departments will resume operations on Monday next. The demand for hoops is steady, and good orders are held at Barrow. At Workington rail orders are only lightly held, and the plant cannot be kept going full time. The foundry trade is fairly well employed.

Shipbuilding and Engineering.

In the shipbuilding and engineering trades most of the departments at Barrow are well employed. Progress is being made with the building of a big Orient liner, and also of a cruiser and a steamer for the Furness-Withy Line.

Fuel.

The demand for steam coal is fuller, and more coke is now being used than for some time past.

Shipping.

The shipping trade is quietly employed. Shipments of pig iron are mostly coastwise, with an odd cargo for the Continent. Steel billets are being imported from Belgium.

SHEFFIELD.

(From our own Correspondent.)

Improvement in Commercial Steel.

THE demand for crude steel, of which Sheffield and district turns out enormous quantities for various commercial purposes, has not been satisfactory for a long time, nor is it so at present, but there are signs of improvement. As a result of the recent reduction in billet prices, buying has been stimulated to some extent. Consumers are apparently coming to the conclusion that they will gain nothing by withholding their contracts any longer, and that, on the contrary, any such action may expose them to the risk of paying higher rates. Producers are, in fact, seriously considering the advisability of raising their charges, which suggests that they are looking forward to an increased flow of orders. At the Templeborough Works of Messrs. Steel, Peech and Tozer, an extra open-hearth furnace has been put into operation, making eight at work out of a total of fourteen. With two or three undergoing repairs, the percentage in commission is well above the recent average. There is a stiffening of the pig iron market, and small advances are asked for forward commitments. The view that trade is improving is supported by the figures of the country's production in October. As compared with September, there was an advance of 33,000 tons of steel and 27,000 tons of pig iron.

Railway Steel.

Of the heavy departments turning out manufactured steel products, one of the busiest is still that devoted to railway supplies. Large orders from the home railway companies are on hand, some of them having been placed only a few weeks ago, and these have now been supplemented by contracts given out by Indian and South American companies. The supplies required include locomotives, wagons, axles, tires and springs. At some of the spring shops, in particular, trade is very good. The capacity of the works is so great, however, and output so rapid, that continuous work cannot be provided without a regular succession of orders, and these are difficult to obtain in the face of Belgian and French competition. In some of the lighter and finished steel branches, trade is very active, and several firms are working up to their full capacity.

A Large Works Deal.

The works of the Sheffield-Simplex Company, at Tinsley, have been purchased from Earl Fitzwilliam by Mr. P. R. Kuehnrich, of Sheffield. The works were built in 1906, and have been several times extended. They were devoted to the manufacture of motor vehicles, and during the war they were also engaged on munitions, including airship parts, and as many as 6000 men were employed. For the past two years they have been practically closed, some parts of the Simplex undertaking having been transferred to a site near London. The works, cover 10 acres, and include one of the biggest engineering shops—extending over 2 acres—of its kind in the world. It is estimated that nearly a million pounds has been spent on the works, and they contain some of the finest machines and plant in the country. Mr. Kuehnrich, the purchaser, although an Austrian by birth, has been a naturalised British subject for many years. He has lived in Sheffield for some thirty years, and is well known in the steel trade. At first in employment as a traveller, he later started business on his own account, and now is connected with the control of nine firms. He intends to use his new establishment—which will be known as the Fitzwilliam Works—for the business of Darwin and Milner, of which he is the directing head. Part of the works will be used for the production of safety razor blades of the firm's cobalt steel, and it is intended to install a plant capable of producing half a million of these articles per day. Cobalt steel safety razor frames are also to be made, as well as various specialities of cobalt steel, including motor engine valves.

Colliery Development.

Activity in the opening up of the coalfield continues, both in South Yorkshire and North Nottinghamshire. The latest report of progress comes from Firbeck Main, the new joint enterprise of the Staveley and Sheepbridge companies, where a depth of 560 yards has now been reached in one shaft, and there is an expectation that coal will be found early in the New Year. Good progress has also been made with the erection of the permanent service equipment. The South Yorkshire Joint Lines Committee of the London and North-Eastern Railway Company has decided to lay a new track to serve this colliery. The line will start at Tickhill, near Rotherham, and will have a length of 6 miles. In its course it will cross ten roads and the river Torne, and will require the provision of several large bridges, in addition to a viaduct over the Tickhill to Maltby main road, consisting of four spans of 50ft. and one of 25ft. The construction of the track, which will be double, will involve the cutting and excavation of about 500,000 cubic yards of hard limestone rock. Messrs. Mitchell Brothers, Sons and Co., of London and Glasgow, are the contractors, and they expect to give employment to over 500 men for one to two years. The new line will run within a couple of miles of the Harworth colliery, and can be linked up to it if required. The owners of that pit have mining rights under some 10,000 acres in the Blyth district, where another colliery will be sunk. It is also expected that in the near future a start will be made with sinking operations at Awkley, in the Doncaster neighbourhood.

Doncaster and Its Tramcars.

While Chesterfield is seriously considering the question of scrapping its present tramways and adopting a new system of public transport, the same problem has also been under discussion at Doncaster. The Electricity and Tramways Committee has had before it the comparative merits of tramcars and trackless vehicles, but has not yet come to a decision. At the last Council meeting an assurance was given that nothing would be done in the direction of superseding the present system without consulting the whole body. In the meantime, the Corporation is going forward with its omnibus scheme, which supplements the trams and provides travelling facilities for people living outside the borough. It has been decided to purchase two new double-deck omnibuses.

Cutlery and Plate.

There is still a great deal of activity in these trades, owing to the special orders for the Christmas season. Bookings are now falling off somewhat, but the firms engaged on the cheap lines will be busy until very nearly the end of the year. The demand for stainless steel cutlery keeps up remarkably well. A great proportion of this trade is in the cheaper grades, but the firms who turn out high-quality goods are quite fairly well off for work. The cutlery trade on the whole has shown some improvement during this year, and the outlook is considered promising. The old-established houses, however, are not employed up to nearly their normal rate. In best hollow ware, spoons, forks and table knives, a fair amount of trade is being provided by orders for hotel and ship equipment. The general trade in best-quality silver and electro-plated hollow ware is still slack.

Quality in Electro-plate.

A discussion is proceeding in Sheffield electro-plate circles on the subject of the marking of goods with indications of quality. It is complained that the use of the letters "A," "B," and "C" no longer gives a reliable indication of the amount of silver deposited upon articles or of the weight and quality of the "nickel silver" which constitutes the base metal of electro-plate. There is nothing to prevent an unscrupulous maker from using the "A 1" quality mark for the most inferior articles. In some cases, it is stated, nickel silver is made with a nickel content as low as 2 per cent., and is little better than brass, while a speaker at a meeting of the Silver

Trades' Technical Society stated that there were cases of dealers selling twelve tablespoons as "double plated spoons," when they contained only 28 grains deposit. The subject bristles with difficulties, and it remains to be seen what line of action will be taken.

New Bridge at Selby.

A scheme is on hand at Selby for building a new bridge to carry the Bawtry main road over the Aire and Calder Canal, about half a mile south of the town. There is at present an old stone bridge, but it is narrow, and there are sharp turns in the road on either side of it. The proposed new bridge, which will be of steel girder construction, will straighten the road, will be 40ft. wide, and will be capable of carrying weights of 30 tons. It is hoped to make a start with the work early in the New Year. The approximate cost is £16,000, of which half will be borne by the Ministry of Transport, £2500 each by the Aire and Calder Navigation and the Selby Urban District Council, and the balance by the West Riding County Council. Eventually, the old bridge will be demolished.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

After a lull on the Cleveland pig iron market for a few days, the position has improved once more, and a fresh spate of business has come along. The weak spot hitherto has been the limited demand from the Continent and the inability of Cleveland makers to compete with the depressed figures at which foreign producers were content to do business. The latter have been selling at a loss in order to dispose of their surplus make, and have consequently cut out Cleveland makers in many markets. But events have been too strong for them. There has been a sharp rise in continental prices during the past few days, and, as a result, Cleveland has been able to secure a few useful export orders to supplement a steady home trade. As a matter of fact, although actual business has not yet matured, there are inquiries circulating for ordinary Cleveland foundry iron for shipment to the United States, and it is stated that there is every probability of sales being arranged. In view of these facts, the price of No. 3 G.M.B. Cleveland pig iron is very firm at 82s. per ton. It has to be remembered that the output is still very limited, and whilst makers are naturally anxious to light up more furnaces and so reduce their overhead charges, this step is not to be lightly undertaken. The permanence of the demand needs to be assured before extra furnaces are started, and consequently a temporary shortage is by no means a remote possibility. In any case there is not much prompt iron about, and sales are being made up to the end of June next on the basis of 82s. per ton for No. 3. No. 1 foundry iron is 87s.; No. 4 foundry, 81s.; and No. 4 forge, 80s.

Hematite Pig Iron.

There is a good demand for East Coast hematite pig iron, and an early expansion of the output is expected if present conditions continue. An interesting feature this week is the fact that a good parcel of hematite has been sold for Transatlantic shipment. The price of mixed numbers is steady at 88s. 6d. per ton, and some sellers ask up to 89s., with No. 1 at a premium of 6d. per ton.

Ironmaking Materials.

The foreign ore trade shows signs of returning animation, and quotations are based on 22s. 6d. per ton for best Rubio ore c.i.f. Tees. The export demand for coke has fallen away again, and prices are weaker, but sellers still ask 25s. per ton for good medium furnace kinds delivered at the works.

Manufactured Iron and Steel.

The improvement in the manufactured iron and steel trade in the North of England is well maintained. There has been a marked relaxation in the severity of foreign competition, a number of continental producers having withdrawn from the market. Moreover, there have been a few orders definitely placed with Northern shipbuilders, which at once react upon the demand for steel, and there is also a better inquiry for railway and constructional material. Galvanised corrugated sheets have stiffened to about £17 10s. per ton, and all other prices are firm and have the appearance of remaining so.

The Coal Trade.

The Northern coal trade is quieter, as merchants, having covered their most pressing needs for prompt position, are not prepared to pay enhanced prices ahead, and consequently are marking time for December supplies. Values, however, are firmer for prompt delivery, and the tone of the market generally is perhaps a little more buoyant. Most of the collieries are not prepared to sell at present quotations, and they declare that unless customers from abroad are prepared to pay more than the present figures, they will be compelled to close down until the turn of the year. Many thousands of miners are still idle in Northumberland and Durham. The demands from abroad are really small in volume if more numerous, and those who have recently been on the Continent searching for business have returned with anything but favourable reports. Production on the Continent is much larger than it was, and the mines are able to offer greater proportions than formerly. In addition the industrial demand is quiet. There are signs, however, that the home market is improving, and with some industries showing revival, the outlook for the coal trade may be regarded as more favourable. Best qualities of steam coals remain fully steady at 18s. 3d. to 18s. 6d., and these figures are offered for forward deliveries, but sellers ask much higher prices. The demand for steam small coals is moderate, and with output on a bigger scale, prices remain weak. A few contracts for Durham gas coals continue to come forward, the most important this week being that of the Genoa Municipal Gasworks for 30,000 tons of best qualities, for which local merchants recently tendered through Italian merchants at 29s. per ton c.i.f. Shipments are spread over January to May next year. The Durham coking coal trade is dull and stocks ample, and prices remain weak at 17s. to 18s., but at the same time there is very little forward business, sellers not wishing to commit themselves in face of reports that many blast-furnaces are expected to be restarted during the next few weeks. The bunker coal trade is quietly steady, with best brands at 18s. to 19s., and ordinary 17s. 6d. to 18s. The coke position is quiet, but the best gas qualities are in better demand. Prices are unchanged, as stocks of gas coke are extensive. Foundry coke remains a slow trade.

SCOTLAND.

(From our own Correspondent.)

The Course of Trade.

Generally speaking, the industrial situation in Scotland is extremely disappointing, and gives rise to a considerable amount of anxiety. This, the normally busy season, is wearing on without any appreciable alteration in conditions, and the outlook is as problematical as ever. In some, if not all, trades, many producers have been forced to cut production, owing to increasing stocks, and to the impossibility of selling at a figure showing a profit on the high oncost charges. As the last-named charges are becoming relatively higher as production decreases, the question of temporarily closing down must be a serious consideration to many concerns where a semblance of activity has been preserved in the hope of a turn for the better. Foreign competition is still rife, but it is said that quotations from abroad have a firmer tendency, and local makers may take some encouragement from this fact, although there is still a considerable difference in foreign and local prices. There has been some talk of increasing employment in the Clyde shipyards, and if it should prove true, there is little doubt that West of Scotland steel and ironworks will benefit to some extent. On the whole, however, few opinions favour the possibility of any appreciable increase in business until the turn of the year at the earliest.

Pig Iron.

The tone of the pig iron market has become a shade firmer, in view of more inquiry on home account. Lacking a corresponding increase in actual business, however, prices are still nominally unchanged at £4 15s. per ton for hematite and No. 1 foundry, and £4 10s. per ton for No. 3 foundry. There is no sign so far of an increased turnover in export directions, and prices for that class of business are purely a matter of arrangement, and are subject to considerable fluctuation.

Steel and Iron.

The one strong feature of the steel trade is the demand for light sheets, especially for export. Both black and galvanised descriptions are well bought, and the price of the latter is firm at £18 5s. per ton for 24 b.g., f.o.b. Glasgow. Heavy steels could be much busier, however. While there is a more hopeful feeling in respect to plates and sections, the probability of securing orders against the foreign imports is a thin one, so long as the discrepancy in prices is so pronounced. At present imported ship plates, for instance, are from 30s. to 40s. per ton cheaper than the home product. Therefore, unless home materials are specified, makers can hardly hope to benefit from increased activities at the shipyards.

Bar Iron Dull.

A run round the bar iron works is not a very inspiring experience at present. Only with the greatest difficulty can makers keep a section of the plants in operation, and this applies equally in the steel re-rolling department of the industry. Occasional orders come to hand for the lighter varieties of bars, angles, &c., but the general demand is most unsteady. Little, if any, advantage has accrued from the 10s. per ton reduction in prices of bar iron. Re-rolled steel also is irregular, and the price fluctuates round about £9 per ton, home or export.

Depression in Coal Trade.

It is said that probably never in the history of the coal industry has there been a period of greater depression than is at present being experienced, more especially, perhaps, in the export department. All descriptions and qualities of fuel, almost without exception, are greatly in need of orders, especially in view of the fact that many existing contracts expire at the end of the present year. Owing to cheap continental fuel, home collieries are forced to concede practically sacrificial prices for comparatively small immediate orders, or refuse to entertain the business at all. Firmer prices are named for forward transactions, but buyers cannot be persuaded to purchase over a period under present conditions. Outputs have been reduced almost everywhere, and further curtailment is imminent. Round coals and washed materials in all districts are similarly affected. Shipments for the past week amounted to 264,251 tons, against 255,515 tons in the preceding week and 309,934 tons in the same week last year. In the home market supplies are easily secured, and in many cases prices can be arranged.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

Taken on the whole, the position in the steam coal trade has been a shade better during the past week for the reason that the tonnage at the disposal of coal-owners has been rather more plentiful, and, as a result, work at most of the collieries has been of a slightly more regular character. The conditions, however, still leave much to be desired in the way of an improvement in prices. In this respect there has been no alteration, so far as the superior grades of coal are concerned, though the inferior qualities have been somewhat erratic. Naturally coalowners are doing their utmost to resist any further reduction, because this would have an adverse influence upon business over next year. Up to now there has not been a big volume of operations in coals over 1925, though the British Admiralty has purchased supplies, and it is reported that one or two colliery undertakings have sold a fair quantity of coals, notably superior second Admiralty large coals at 25s. 9d., and ordinary Admiralty large at 25s., which prices are a reduction of about 1s. upon the current year's contracts. There is other business which has yet to be placed, but many exporting firms are still holding back in view of their doubts regarding the prospects of next year, and the fact that they are making losses in many instances on their current contracts.

Later.

Although nothing official has been disclosed, it is understood that the basis of the purchases by the British Admiralty of South Wales steam coals for delivery over next year is 27s. for best Admiralty large and 26s. for superior second Admiralty large.

German Competition.

A brief reference was made to the menace of German competition last week, more especially as it concerns Portugal; but, of course, this is not the only direction in which foreign competition has to be faced. The seriousness of it was exemplified more particularly in the case of Portugal. Published correspondence between local firms and their Lisbon houses showed that Hugo Stinnes and Co. had been endeavouring to bring influence to bear upon the Portuguese Government to secure the introduction into that country of German coals as a form of reparation. No doubt such a proposal would have an appealing force in view of the fact that it would enable manufacturers and consumers to obtain supplies of coal cheaper than they can be secured from this country, but it appears from latest information to hand, that this scheme has not taken shape. The matter was taken up with the British Government and through the agency of the Chamber of Commerce. While, however, the Germans' project may have been checked, there is still the serious prospect that they may gain a strong footing in Portugal purely by competitive means, as they have undoubtedly a considerable quantity of cheap coal which they can dispose of, and it is doubtful whether South Wales exporters can get down to the level of the prices at which the Germans can supply, unless the coalowners in this district can produce at a much lower cost than is the case at present. Spain is another market where the competition is very severe, and the latest information to hand is that the Spanish mineowners are making strong efforts to secure the prohibition of coal imports from South Wales, so that by the elimination of competition they may improve the demand for native coals and obtain better prices.

Fusion of Copper Manufacturers.

Reference was made some time ago to the prospective amalgamation of firms in the Swansea district producing copper, spelter, &c. Fuller particulars are now disclosed by the registration of British Copper Manufacturers, Limited, with an authorised capital of £1,500,000 divided into 1,000,000 ordinary shares and 500,000 6 per cent. cumulative preference shares of £1 each, of which 800,000 ordinary shares and 400,000 preference shares are being issued on formation. This company has been formed to acquire the undertakings of Vivian and Sons, Limited, and Williams, Foster and Co., Limited, and Pascoe, Grenfell and Sons, Limited, these being the leading copper manufacturing undertakings in the country. All three companies own extensive works in the Swansea district, and as the main works adjoin each other, operating economies can doubtlessly be effected by the amalgamation scheme. The chairman of the new company is Sir R. Sothern Holland, Bart.

Colliery Items.

The report is current that operations may be resumed in certain districts of the Cambrian Combine collieries which have been idle since August 21st. There is no official statement forthcoming regarding this rumour, and it is questionable whether work will be restarted this year. In the case of the Rhondda Main Collieries, Ogmore Vale, the notices served upon nearly 1000 men have expired, and there are fears that the colliery may be permanently stopped.

Current Business.

There has been no appreciable improvement in the inquiry for current supplies of steam coals and values have undergone no alteration of note. Competition is very keen for the comparatively few orders that come on the market. If anything, the superior grades of small coals have improved slightly, but inferior qualities are plentiful. Anthracite coals are very fully stemmed for the remainder of this month and next, and prices keep firm.

EDUCATIONAL INTELLIGENCE.

University of London, University College.—Fifteen entrance scholarships and exhibitions are available for award to students entering University College, London, in October, 1925. One of them is tenable in the Faculty of Science, and one in the Faculty of Engineering. Most of the scholarships and exhibitions are of the value of £40 a year for three years, but the value of any scholarship or exhibition may be increased by the grant of a supplementary bursary if the circumstances of the scholar or exhibitioner make such a grant necessary.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	22.6

PIG IRON.

	Home. £ s. d	Export. £ s. d
(2) Scotland—		
Hematite	4 15 0	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 9 0	4 9 0
No. 1	4 9 6	4 9 6
Cleveland—		
No. 1	4 7 0	4 7 0
Silicious Iron	4 7 0	4 7 0
No. 3 G.M.B.	4 2 0	4 2 0
No. 4 Foundry	4 1 0	4 1 0
No. 4 Forge	4 0 0	4 0 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
„ „ Foundry	4 5 0	—
(3) Northampton—		
Foundry No. 3	3 16 0	—
„ Forge	3 10 0 to 3 12 0	
(3) Derbyshire—		
No. 3 Foundry	4 2 6	—
Forge	3 17 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 6	—
No. 4 Forge	4 0 0	—
Basic	4 5 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 5 0 (a) / 5 10 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d	Export. £ s. d
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E Coast—		
Common Bars	12 0 0	—
Lancs —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best „	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 15 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d	(7) Export. £ s. d
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¾in. and up	9 15 0	—
Sections	9 10 0	—
Steel Sheets, 3/16 in. to ¾in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 5 0

STEEL (*continued*).

	Home. £ s. d	Export. £ s. d
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 10 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 0 0†	—
Light „	9 5 0 to 9 10 0	—
Billets	8 0 0 to 11 10 0†	—
Manchester—		
Bars (Round)	10 0 0 to 10 10 0	—
„ (others)	9 15 0 to 10 0 0	—
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0 to 10 0 0	—
„ (Lancs. Boiler)	13 0 0	—
Sheffield—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 9 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0	—
Hoops	12 10 0	—
Soft Wire Rods	11 0 0 to 11 10 0	—
Midlands—		
Small Rolled Bars	9 5 0 to 10 0 0	—
Billets and Sheet-bars	7 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	17 10 0	—
Angles	9 5 0	—
Joists	9 5 0	—
Tees	10 5 0	—
Bridge and Tank Plates	9 15 0	—
Boiler Plates	13 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/6 to 23/7½
Block Tin (cash)	257 15 0
„ (three months)	260 15 0
Copper (cash)	64 2 6
„ (three months)	65 2 6
Spanish Lead (cash)	39 7 6
„ (three months)	37 10 0
Spelter (cash)	35 11 3
„ (three months)	35 5 0
Manchester—	
Copper, Best Selected Ingots	70 0 0
„ Electrolytic	71 0 0
„ Strong Sheets	94 0 0
„ Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0
„ „ Condenser	0 1 2½
Lead, English	42 15 0
„ Foreign	41 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
„ 6 p.c. to 8 p.c. „	£23 10 0	7/9
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£43 0 0	16/-
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£60 0 0	20/-
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
„ „ 75 p.c.	£17 17 6 scale 6/- per unit	
„ Vanadium	16/3 per lb.	
„ Molybdenum	7/9 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/- per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	16/9
„ „ Ell	18/6
„ „ Splint	19/- to 21/6
„ „ Trebles	20/-
„ „ Doubles	19/-
„ „ Singles	13/3
Ayrshire—	
(f.o.b. Ports)—Steam	16/9
„ „ Splint	19/-
„ „ Trebles	20/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	15/- to 17/3
Screened Navigation	25/-
Trebles	22/6 to 23/-
Doubles	19/- to 19/6
Singles	14/-
Lothians—	
(f.o.b. Leith)—Best Steam	16/6
Secondary Steam	15/6
Trebles	20/3
Doubles	19/-
Singles	13/9

ENGLAND.

(8) N.W. Coast—	
Steams	28/6
Household	45/- to 58/4
Coke	30/-
Northumberland—	
Best Steams	18/6
Second Steams	17/6 to 18/-
Steam Smalls	10/9 to 11/-
Unscreened	15/6 to 17/-
Household	23/6 to 25/-
Durham—	
Best Gas	21/-
Second	17/3 to 18/-
Household	23/6 to 25/-
Foundry Coke	23/-
Sheffield—	Inland.
Best Hand-picked Branch	32/- to 35/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	27/- to 32/- —
„ „ House	24/- to 26/- —
„ „ Large Nuts	22/6 to 25/- —
„ „ Small „	14/- to 16/- —
Yorkshire Hards	21/6 to 23/6 —
Derbyshire „	21/- to 23/- —
Rough Slacks	9/6 to 12/- —
Nutty „	9/- to 11/- —
Smalls	5/- to 8/6 —
Blast-furnace Coke (Inland)*	—
„ „ (Export)	f.o.b. 25/- to 25/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/- to 27/6
Second „ „	25/6 to 26/6
Best Dry Large	27/- to 27/6
Ordinary Dry Large	24/ to 26/-
Best Black Vein Large	24/- to 24/6
Western Valley „	23/6 to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary „ „	22/6 to 23/-
Best Steam Smalls	16/- to 17/-
Ordinary „	13/- to 15/-
Washed Nuts	28/- to 31/-
No. 3 Rhondda Large	27/- to 27/6
„ „ Smalls	19/- to 20/-
No. 2 „ Large	22/6 to 23/6
„ „ Through	18/- to 20/-
„ „ Smalls	11/- to 13/-
Foundry Coke (export)	40/- to 47/6
Furnace Coke (export)	27/6 to 32/6
Patent Fuel	25/6 to 27/6
Pitwood (ex ship)	30/- to 30/6
Swansea—	
Anthracite Coals	
Best Big Vein Large	47/6 to 50/-
Seconds	40/- to 45/-
Red Vein	32/6 to 35/-
Machine-made Cobbles	59/- to 60/-
Nuts	55/- to 60/-
Beans	42/6 to 45/-
Peas	19/- to 23/-
Breaker Duff	9/6 to 10/-
Bubbly Culm	11/6 to 12/-
Steam Coals:	
Large	21/6 to 23/6
Seconds	22/- to 22/6
Smalls	14/- to 16/-
Cargo Through	17/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast furnaces only, 16/9, with fluctuations according to analysis; open market, round about 22/6 to 25/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Tariffs and Trade.

THE policy of putting up import duties as a means of bargaining for reciprocal advantages with other countries is being carried to greater lengths than ever before. This phase of commercial warfare is not without causing serious friction, and during the past week a feeling of irritation has been provoked in this country by Belgium unexpectedly raising her import duties at a time when the new *modus vivendi* was to come into operation. In view of the application of the new Belgian Tariff Bill, the two countries came to an understanding whereby specially favoured treatment should be accorded in respect of certain classes of goods, which would otherwise have been almost wholly excluded, and it is now ascertained that the Belgian duties are being still further increased, to the extent of suppressing completely the advantages of the *modus vivendi*. The Belgians affirm that the increased duties are imposed as a protection against German competition and that the French negotiators must have known that it was the intention of the Belgian Government to increase the duties. As, however, some of the new duties apply more to French than to German products, the explanation does not satisfy commercial people here. The Government announces its intention to take such measures as may be necessary for the protection of French interests, and unless some satisfactory compromise is effected by the Belgians it is feared that a policy of retaliation will be adopted, which will mean a practical suspension of business between the two countries.

Oil Deposits.

The numerous borings for oil carried out in different parts of the country had, until recently, given such poor results that there appeared to be very little hope of finding deposits of sufficient importance to justify their being worked on an industrial scale. Nevertheless, the borings have revealed natural gas and water impregnated with oil, and the Comité Scientifique du Pétrole, which includes some of the most eminent geologists, has been guiding researches, particularly in the Hérault, Auvergne and Seine Inférieure. At Gabian, in the Hérault, between Béziers and Paulhan, exudations of oil have been observed for centuries, but surface borings carried out during the past ten years gave no encouraging results until two months ago, when a bore, carried to a depth of 97 m., brought to the surface from 5 to 10 gallons of oil an hour. The Comité Scientifique du Pétrole then directed research on behalf of the State and entrusted the work of boring to the Société de Pechelbronn, which carried a bore to a much greater depth in the same district and last week tapped a deposit that has since been flowing at the rate of a ton an hour. If this rate of flow be maintained it will allow of the industrial working of the only deposit yet found in France besides the one at Pechelbronn in Alsace. The success of the Gabian boring operations has stimulated interest in researches elsewhere. A vast amount of money has already been spent in fruitless borings, although in the case of Vaux-en-Bugey it has found adequate return in natural gas, and fresh borings are to be carried out in Auvergne and other districts.

Carbonisation.

Amongst the various sources of fuel supply to which attention is being given at the present moment the most practical and immediate results are being obtained with charcoal in suction gas plants, and the Commission de la Carbonisation has decided to organise, in the spring, trials of portable apparatus for making charcoal. At present the country only produces 150,000 tons of charcoal a year. It is estimated that it is possible to bring the production up to a million tons without destruction of forests, and it is hoped to facilitate manufacture by the aid of portable carbonising plants. If the price of the fuel is not to increase unduly there must be an abundant supply. At the same time, the Commission de la Carbonisation is carrying out a particularly exhaustive series of tests with different types of suction gas plants employing charcoal as a fuel.

Seamen's Hours.

The efforts of seamen to ensure an application of the eight hours' working day are a perpetual source of trouble between the men and shipowners. France is the only country in which an eight hours' working day can be legally enforced in the merchant marine. As a matter of fact, it is not enforced because it is impossible of application so long as other countries refuse to adopt similar legislation, and the French Government and the Seamen's Union has been making persistent efforts to bring the British Government and seamen round to its point of view. The present Socialist Government now finds itself in a dilemma, for Great Britain has absolutely refused to support any international agreement on this matter, and while the French Government is committed to an eight hours' day for seamen it is unable to move unless the legislation is international. The problem will therefore always present an element of discord.

The Russian Fleet.

The recognition of the Soviet Government has had the unexpected result of enabling it to claim from France the return of the Russian fleet which sought refuge in the port of Bizerta after the defeat of General Wrangel. The fleet consists of two battleships, a cruiser, seven destroyers, three torpedo boats, two gunboats, and other small craft, as well as a repair ship. Some of them are quite modern, one of the battleships of 23,000 tons having been launched in 1914, and they have been kept in a good state of repair. The restitution of this fleet is naturally raising many legal and political difficulties, for it would give to the Soviet an absolute control over the Black Sea. The French Government, however, is not likely to relinquish the fleet until payment for the cost of maintenance is made, and by the time that is done the ships may be obsolete.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

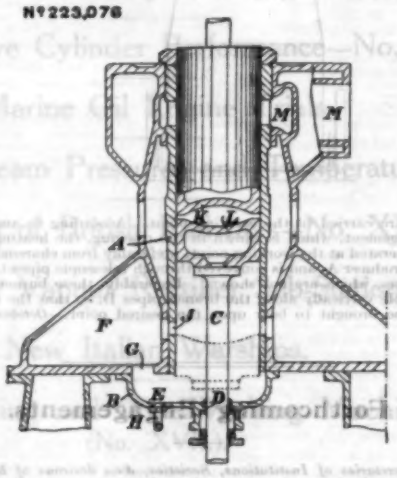
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

223,076. November 30th, 1923.—TWO-STROKE ENGINES, A. N. Grierson, 29, Glasgow-road, Paisley.

The object of this invention is to prevent gases, carbonised cylinder oil and the like, leaking past the piston, from contaminating the lubricating oil of the other moving parts of the engine. The lower end of the cylinder A is closed by a removable cover B, through which passes the piston-rod C, usual packing D being provided in the cover. The space E enclosed by the cover B is put in constant communication with the

N° 223,076



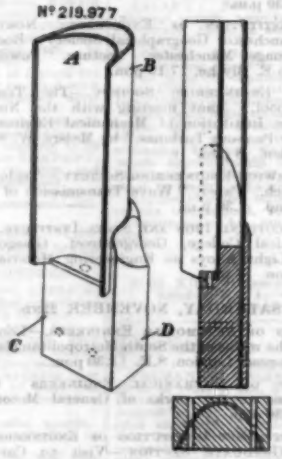
scavenge air receiver space F, which is at the lower end of the cylinder (the exhaust receiver space M being at the upper end) by means of a passage G. A drain pipe H fitted with a valve (not shown) is led from the bottom of the cover B. The usual ports J in the cylinder wall allow the scavenge air to enter the cylinder between the pistons K L when these ports are uncovered by the upper edge of the lower piston L about the outer end of its stroke, as shown in dotted lines. Two alternative arrangements are also given in the specification.—*October 16th, 1924.*

TURBINE MACHINERY.

219,977. July 26th, 1924.—IMPROVEMENTS IN AND RELATING TO TURBINE BUCKETS AND METHODS OF MANUFACTURING SAME, *The British Thomson-Houston Company, of Crown House, Aldwych, W.C.* 2.

Turbine blades constructed in accordance with this inven-

N° 219,977



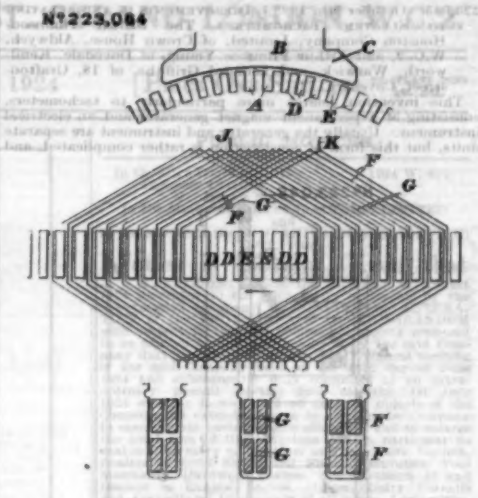
tion have front and back walls formed of two curved pieces of sheet metal A and B, which are united along their edges. The back wall extends throughout the length of the bucket, whilst the front wall terminates at the top of the base, which is made in two pieces C and B.—*October 16th, 1924.*

DYNAMOS AND MOTORS.

223,064. November 9th, 1923.—IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, The English Electric Company and Herbert Barnes, both of Queen's House, 28, Kingsway, W.C. 2.

According to this invention, the dimensions of the slots and teeth of the armature of a synchronous rotary converter are proportioned, so that any material variation in the local reactance of the path for the magnetic flux for a given position under the pole face as the different teeth move past that point is avoided. A six-pole armature, having fifteen slots of equal depth per pole, is denoted by the letter A, whilst one of the six poles is denoted by B and a pole shoe by C. The ninety armature slots are arranged around the armature circumference in eighteen groups of five slots per group, each group occupying sixty electrical degrees of the armature circumference. Three of each five are narrow slots D, and two are wide slots, as shown at E. The armature winding scheme will be clear from the middle drawing, wherein the wide conductors F, shown by the heavy lines, are arranged in the wide slots, and the narrow conductors G, shown

N° 223,084



by the light lines, are arranged in the narrow slots D. The wide conductors F are tapped at points J and K, &c., at intervals of 60 electrical degrees around the winding, and they are connected to slip rings in the usual manner. The particular points at which the wide conductors are tapped depend upon the power factor.—*October 16th, 1924.*

TELEGRAPHS AND TELEPHONES.

217,601. June 13th, 1924.—IMPROVEMENTS IN RADIO RECEIVING SYSTEMS, Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H., of Hallesches ufer 12/13, Berlin, Germany.

The object aimed at by the inventors is to provide a simple receiving apparatus, which will eliminate disturbing oscillations. Between the usual aerial and earth connections additional apparatus is inserted as shown. C is a condenser, which has a

N° 217,601

capacity at least twice as large as that of the aerial. Leads D from the two sides of the condenser are connected to the receiving set, and a condenser F is connected in series with one of these leads. The usual tuning inductance and condenser are shown at L and K respectively. With the aid of the additional apparatus shown on the left, greater selectivity can be secured than is possible with the usual arrangement.—*October 16th, 1924.*

223,061. June 13th, 1924.—IMPROVEMENTS IN WIRELESS TELEGRAPH AND TELEPHONE RECEIVING APPARATUS, Mann, Egerton and Co., Limited, 5, Prince of Wales's-road, Norwich, and Harold Robey Tainton, of 21–23, King-street, Norwich.

The object of this invention is to increase the stability of electrical oscillations and to obtain a stronger amplification,

N° 223,061

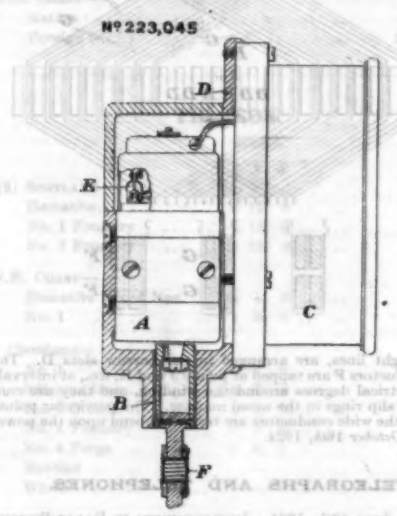
preferably from a single valve, though more valves may be employed. A supplementary circuit A connects the anode circuit with the aerial circuit. B is the secondary winding of a high-frequency transformer shunted by a variable condenser C,

The primary winding of the high-frequency transformer is shown at D. The remainder of the circuit is self-explanatory. The condenser C is used for fine tuning.—*October 10th*, 1924.

MEASURING AND TESTING INSTRUMENTS.

223,045. October 9th, 1923.—Improvements in and relating to Electric Tachometers, The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2, and Arthur Primrose Young, of Dovedale, Kenilworth, Warwick, and Leonard Griffiths, of 18, Grafton-street, Coventry.

This invention relates more particularly to tachometers, consisting of a permanent magnet generator and an electrical instrument. Usually the generator and instrument are separate units, but this form of construction is rather complicated, and

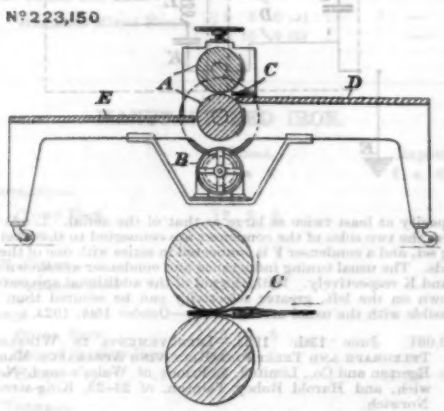


the object of this invention is to provide a more compact construction. In the drawing A represents the permanent magnet generator mounted in a casing. The generator is driven through a sleeve B and a spring coupling F. A moving coil or other suitable electrical indicating instrument C is secured by means of screws to a flange D on the casing, and has its terminals connected to the generator terminals. A rheostat E fitted to the generator end plate is in series with the instrument and generator, and serves for calibration purposes.—*October 16th*, 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

223,150. April 7th, 1924.—Apparatus for Separating Metal Plates, C. Alsnauer, 330, Shenango Boulevard, Farrel, Penn.

This machine is intended for separating the "stickers" or sheets stuck together, which are sometimes produced when rolling thin metal in packs or multiple layers. It comprises a pair of rolls A A, driven by a motor B, in front of which there is fixed a sharp-edged knife C. In operation, a pair of stuck sheets is first separated by hand at the edges, and sufficiently far

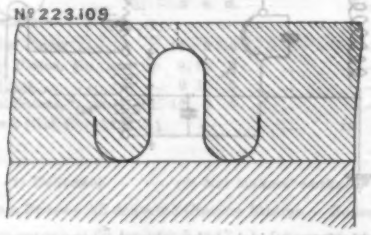


back to admit of insertion over and under the knife, and into the grip of the rolls. Thereafter, as the sheets are pushed over table D, which is just below the knife, the bite of the rolls will draw the sheets forward over the knife blade, effecting complete and rapid separation, the two separated sheets passing onward between the rolls and out on to the lower receiving table E beyond. The action of the rolls on the sheets tends to flatten and smooth any wrinkles or bends, leaving them in good merchandisable condition.—*October 16th*, 1924.

BUILDING.

223,109. February 4th, 1924.—Expansion Joints for Concrete, J. F. Goddard, 10, Upper Woburn-place, London, W.C. 1.

This joint is intended to accommodate the expansion and

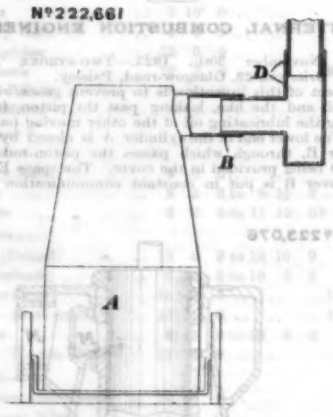


contraction of concrete, and also to prevent moisture finding its way to the foundation. It comprises a flexible strip of material, bent as shown and embedded in the concrete. Any moisture finding its way through cracks in the concrete at the joint is caught by the trough-like sides of the flexible strip.—*October 16th*, 1924.

MISCELLANEOUS.

222,661. September 27th, 1923.—Improved Process for Winning Rock and Minerals, Josef Schejbal, of Lebcice, near Novy Knin, Czechoslovaki.

This invention relates to an improved means of winning rocks and minerals, which involves heating the rocks by means of a flame, which is brought to the working point by means of a transportable apparatus. Compressed or liquefied gases and liquid fuels may be stored in bottles or similar portable vessels,



and are carried to the working point. According to another arrangement, which is shown in the drawing, the heating gas is generated at the working point, preferably from charcoal in a gas producer A, and is conveyed through telescopic pipes to the burners, which are not shown. Preferably, these burners are slidable vertically along the branch pipes D, so that the flame can be brought to bear upon the desired point.—*October 9th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Engineers and Shipbuilders in Scotland.—Grosvenor Restaurant, Gordon-street, Glasgow. "James Watt" dinner. 6 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Report of the Marine Oil-engine Trials Committee. 6 p.m.

Institution of Production Engineers.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "Gear Cutting, with Special Reference to the 'Sykes' Generating System," by Mr. O. H. Medcalfe. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street London, S.W. 1. Lecturette, "Stainless Steel," by Mr. J. G Hopcraft. 7.30 p.m.

Junior Institution of Engineers: North-Western Section.—Manchester Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. Lecture, "Powdered Fuel," by Mr. George E. Blythe. 7.15 p.m.

Liverpool Engineering Society.—The Temple, Dale-street, Liverpool. Joint meeting with the North-Western Branch of the Institution of Mechanical Engineers. Paper, "Reducing or Pass-out Turbines," by Messrs. W. S. Burgo and P. J. Chittenden. 8 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Paper, "Wave Transmission of Power," by Mr. G. H. Hone. 7.30 p.m.

West of Scotland Iron and Steel Institute.—Room 24, Royal Technical College, George-street, Glasgow. Paper, "Steel and Light Alloys as Engineering Materials," by Dr. Leslie Aitchison. 7 p.m.

SATURDAY, NOVEMBER 22ND.

Institution of Automobile Engineers.—London Graduates' visit to the works of the South Metropolitan Gas Company, 709, Old Kent-road, London, S.E. 2.30 p.m.

Institution of Mechanical Engineers: Graduates' Section.—Visit to the works of General Motors, Limited, Hendon. 10.30 a.m.

North-East Coast Institution of Engineers and Shipbuilders: Graduate Section.—Visit to Carville Power Station. 2.30 p.m.

MONDAY, NOVEMBER 24TH.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Further discussion on Chief Constable A. E. Bassom's paper, "Transport on the Highway." 5.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "Modern Colour Problems. I.," by Dr. L. C. Martin. 8 p.m.

TUESDAY, NOVEMBER 25TH.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "The Rôle of Technical Training in Marine Engineering," by Mr. D. Laugharne Thornton. 6.30 p.m.

Institution of Automobile Engineers.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Body Building," by Mr. W. W. Small. 7.15 p.m.

Institution of Automobile Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Informal meeting. Demonstration and discussion on ear cleaning devices. 7 p.m.

Institution of Electrical Engineers: North Midland Centre.—Hotel Metropole, King-street, Leeds. Paper, "Automatic and Semi-automatic Rectifier Sub-stations," by Mr. G. Rogers. 7 p.m.

Institution of Municipal and County Engineers.—Ye Olde Castle Restaurant, Castle-place, Belfast. Irish District meeting. 1 p.m.

WEDNESDAY, NOVEMBER 26TH.

Architects' and Surveyors' Assistants' Professional Union: Metropolitan Branch.—Showrooms of the National Radiator Company, 439-441, Oxford-street, London, W. 1. Film and lantern slides, illustrating ideal radiators, heating, hot water supply, &c. 6.30 p.m.

Institution of Automobile Engineers.—Birmingham Graduates' visit to Aerial Works, Limited, Bournbrook. 2.30 p.m.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, 244, Deansgate, Manchester. Paper, "Automobile Coachbuilding," by Mr. Martin. 6.30 p.m.

Royal Microscopical Society.—20, Hanover-square, London, W. 1. Joint meeting with the Institution of Structural Engineers. Lecture demonstration, "The Elementary Principles of Microscopical Illumination: (2) Self-luminous Objects," by Mr. J. E. Barnard. Paper, "The Application of Microscopy to Cement Research," by Mr. H. J. Deane. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Talking Motion Pictures," by Mr. C. F. Elwell. 8 p.m.

University of London.—University College, Gower-street, London, W.C. 1. "High-frequency Electric Measurements. Lecture V.: Telephonic Measurements," by Professor J. A. Fleming. 5 p.m.

THURSDAY, NOVEMBER 27TH.

Institution of Automobile Engineers.—Training School of Vauxhall Motors, Limited, Luton. Luton Graduates' meeting. Paper, "Production," by Mr. G. D. Ricketts. 7.30 p.m.

Institution of Locomotive Engineers (London).—The Engineers' Club, Coventry-street, London, W. 1. Paper, "Automatic Train Control," by Mr. F. J. Hookham. 7 p.m.

FRIDAY, NOVEMBER 28TH.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. "Centrifugal and Rotary Pumps," by Mr. G. L. Ponsford. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Exhibition of latest scientific instruments and appliances for the use of engineers. 6.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society, Newcastle-on-Tyne. Paper, "The Prediction of Critical Speeds in Ship Resistance," by Mr. J. Tutin. 7.30 p.m.

Royal Meteorological Society.—Imperial College of Science and Technology, South Kensington, London, S.W. 7. Joint meeting with the Physical Society. Discussion on "Ionisation in the Atmosphere, the Influence on the Propagation of Wireless Signals." 5 p.m.

MONDAY, DECEMBER 1ST.

Junior Institution of Engineers: North-Western Section.—Manchester Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. Lecture, "Modern Locomotive Lubrication Practice," by Mr. B. Spencer. 7.15 p.m.

TUESDAY, DECEMBER 2ND.

Institute of Marine Engineers.—85-88, The Minories, Tower-hill, London, E. 1. "Fire and Fire Protection," by Mr. R. B. Stewart. 6.30 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Paper, "The Further Development of Large Power Diesel Engines," by Mr. W. D. McLaren. 7.30 p.m.

West Yorkshire Metallurgical Society.—George Hotel, Huddersfield. Discussion on "The Corrosion of Engineering Materials." 7.30 p.m.

WEDNESDAY, DECEMBER 3RD.

Institution of Sanitary Engineers.—Caxton Hall, Westminster, London, S.W. 1. Paper, "House Drainage, with Special Reference to the Intercepting Trap," by Mr. H. A. Roechling. 7.30 p.m.

University of London.—University College, Gower-street, London, W.C. 1. "High-frequency Electric Measurements. Lecture VI.: Electric Radiation," by Professor J. A. Fleming. 5 p.m.

THURSDAY, DECEMBER 4TH.

Junior Institution of Engineers: North-Western Section.—Visit to the works of Marine and Locomotive Superheaters, Limited, Mosley-road, Trafford Park, Manchester. 7 p.m.

FRIDAY, DECEMBER 5TH.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Extra general meeting. "The Effect of Low and High Temperatures on Materials," by Professor F. C. Lea; and "The Elastic Limit in Tension, its Influence on the Breakdown by Fatigue," by Mr. J. M. Lessells. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Metal Cutting under Water by the Oxy-acetylene Blow-pipe," by Mr. J. B. Pollard. 7.30 p.m.

SATURDAY, DECEMBER 6TH.

Institute of British Foundrymen: Birmingham Branch.—Chamber of Commerce, New-street, Birmingham. "Malleable Iron," by Mr. D. Wilkinson. 3 p.m.

Scholarships in Engineering.—The Council of the British Electrical and Allied Manufacturers Association (Inc.) has recently granted the following scholarships and renewals of scholarship tenable for one year, each of the value of £100, together with the payment of college fees:—In Electrical Engineering: John Tempest Birtwell, tenable at the College of Technology, Manchester; George Emil Gregson Foden, tenable at the College of Technology, Manchester; Percy James Maggs, tenable at the City and Guilds (Engineering) College, South Kensington; Harold Giles Richards, tenable at Birmingham University; Raymond Robinson, tenable at Durham University. In Mechanical Engineering: John Charles Burke, tenable at the College of Technology, Manchester. Renewals of Scholarship: Arthur Bernard Everest, tenable at Birmingham University; Isaac Herdman Hedley, tenable at Durham University; George Sail Campbell Lucas, tenable at the City and Guilds (Engineering) College, South Kensington; Bruce Sydney Pelton, tenable at the University of London.